2006 Applicant Guidelines for Doctoral Programs (Second Stage) of Graduate School of Information Science, Nagoya University (Draft)

Important Notice: The Japanese version of Applicant Guidelines for Doctoral Programs of Graduate School of Information Science, Nagoya University serves as the official guidebook. This English translation is provided only for applicants' convenience.

The Graduate School of Information Science invites applicants for admission to the second stage of doctoral programs for the academic year 2006, in accordance with these guidelines.

1. Qualifications for Application

Applicants must meet one of the following conditions:

(1) Master's degree or professional degree holders, or those who are expected to obtain one of the above degrees by March 31, 2006
(2) Persons who have obtained the equivalent of a master's or professional degree in foreign countries
(3) Persons who have completed or will complete by March 31, 2006 a course of study in Japan through a correspondence course run by an educational establishment in a foreign country, to obtain the equivalent of a master's or professional degree
(4) Persons who have completed a course of study in a foreign educational facility in Japan, which is recognized as forming part of the education system in that foreign country, and which is approved by the Minister of Education, Culture, Sports, Science and Technology, Japan as completing a designated course of study and who hold a master's or professional degree or the equivalent of such a degree
(5) Persons who have been approved by the Minister of Education, Culture, Sports, Science and Technology (Notification No.118 of the Ministry of Education, 1989) (Note)
(6) Persons who will be 24 years of age as of March 31, 2006, and who have been recognized by our Graduate School, based on the results of individual examinations, as having academic abilities equivalent or superior to master's degree holders (Note)

(Note) Applicants who meet condition (6) above must contact our Graduate School no later than December 14 (Wed.), 2005.

2. Number of Students to Be Admitted

Dept. of Computer Science and Mathematical Informatics	9
Dept. of Information Engineering	10
Dept. of Media Science	8
Dept. of Complex Systems Science	14
Dept. of Systems and Social Informatics	7

3. Application Period

Applications will be accepted between January 18 (Wed.) and January 24 (Tue.), 2006 from 9:00 to 16:00 (except between 12:00 and 13:00).

4. Application Documents

Documents required for all applicants

(1) Application Form (Complete form prescribed by our Graduate School)
(2) Examination Card and Photograph Card (Complete cards prescribed by our Graduate School)
(3) Objectives and Study Plan (Complete form prescribed by our Graduate School)
(4) Personal History (Complete form prescribed by our Graduate School)
(5) Receipt of Payment, a copy of the Receipt of Payment (Enter only your name in forms prescribed by our Graduate School.)
(6) 2 self-addressed return envelopes (one for sending Examination Card, the other for correspondence) You must submit 2 self-addressed envelopes prescribed by our Graduate School with the address at which you will receive the envelopes, prefecture code, and name. You must attach a 350-yen stamp on the return envelope for sending Examination card. <u>However, those who bring the application forms to the Graduate School need to prepare only one envelope for correspondence</u>.
(7) Address label (Write necessary items on the label prescribed by our Graduate School.)
(8) Certificate for (prospective) acquisition of master's degree, or certificate for (prospective) completion of master's course
(9) Official transcript of academic records (issued by your last graduate school)
(10) Examination fee (30,000 yen by postal money order, on which name and address of designated payee should not be written.) However, in the case of applicants who wish to advance to the second stage of our doctoral programs directly after finishing the first stage, examination fee and receipt-related forms listed in (5) above are not required.
(11) A master's thesis (a copy is acceptable) and an abstract of the thesis (if applicant finished the master's course without submitting a master's thesis, a research paper can be substituted.) However, applicants who are expected to obtain a master's degree by March 31, 2006 need not submit a master's thesis, only an abstract of the thesis.
In preparing an abstract, applicants may either write in the form prescribed by our Graduate School or type the entire form using a word processor etc. Additional sheets may be used as necessary.

Documents to be submitted preferably for reference

(1) If the applicant has material other than a master's thesis that indicates his/her research abilities, it is desirable to submit a copy of such material and, if necessary, an abstract.
(2) If a foreign applicant studying in Japan has taken the Japanese Language Proficiency Test, it is desirable to submit a certificate or score report thereof. When submitting a copy, write "This document is identical to the original" on the copy, which should then be signed and/or stamped with your seal.
(3) If the applicant has taken an English proficiency test (STEP, TOEIC, TOEFL etc.), it is desirable to submit a certificate or score report thereof. When submitting a copy, write "This document is identical to the original" on the copy, which should then be signed and/or stamped with your seal.

Documents to be submitted in special cases

(1) Foreign applicants residing in Japan must submit an alien registration certificate issued by their municipality office. However, those with permanent residency need not submit this document. Overseas residents must submit a document certifying their nationality and resident's eligibility (for example, a copy of your passport showing nationality and resident status.)
(2) Applicants serving in government and other public offices, companies and other organizations and who will remain in service even after enrollment must submit the organization's written consent to application for admission (no fixed form).

5. Application Procedures

Applicants must put all documents required for application in the envelope prescribed by our Graduate School for sending application documents, address it to the Academic & Students Affairs Section (kyomu-gakusei-gakari) of the Graduate School of Information Science, and either bring it to the Academic & Students Affairs Section (kyomu-gakusei-gakari) in person or send it by mail.

Points of note

(1) Applicants are recommended to bring the application documents to the Academic & Students Affairs Section (kyomu-gakusei-gakari) in person.
(2) When applicants send the application documents by mail, use **registered mail** and write on the front side of the envelope "(Graduate School Application Forms Inside)" in red ink to reach the Academic & Students Affairs Section (kyomu-gakusei-gakari) of the Graduate School of Information Science by 16:00, January 24 (Tue.), 2006.
(3) The examination card is issued following receipt of the application documents. (However, when application documents are sent by mail, it will be sent to the applicant by mail.)
(4) Incomplete application documents will not be accepted.
(5) After an application has been filed, we will not allow any changes to application documents, nor refund examination fees.

6. Selection

(1) Successful applicants for admission to our programs will be selected on the basis of overall evaluation of the result of the oral examination and application documents.
(2) The oral examination schedule is shown below. However, applicants who cannot meet the schedule due to exceptional circumstances may be allowed to take the examination at a later date. Be sure to contact the Academic & Students Affairs Section (kyomu-gakusei-gakari), Graduate School of Information Science, at the time of filing an application.
(3) Announcement of the oral examination venues will be posted on the examination day at the entrance to the Graduate School of Information Science building (see attached map).
(4) Applicants must arrive at the examination rooms at least 30 minutes before the start time of the examination and follow the instructions of the clerk in charge.

Oral examination

Department	Date	Time
Computer Science and Mathematical Informatics	February 15 (Wed.)	9:30 -
Information Engineering	February 15 (Wed.)	9:30 -
Media Science	February 15 (Wed.)	9:30 -
Complex Systems Science	February 15 (Wed.)	9:30 -
Systems and Social Informatics	February 15 (Wed.)	9:30 -

Notes: The oral examination comprises presentation of master's thesis or substitute research paper (approximately 20 minutes), questions and answers about the presentation, and questions about the major academic field to which the candidate is applying for admission. For presentation, an OHP or liquid crystal projector may be used. It should be noted, however, that the applicant must bring a personal computer to be connected to the liquid crystal projector.

7. Announcement of Admissions

Announcement of admissions will be posted at noon, February 17 (Fri.), 2006, at the entrance to the Graduate School of Information Science building. The results will also be communicated to each applicant by mail.

8. Registration Procedures

Registration procedures will be communicated to prospective students in early March 2006. The procedures should be carried out toward the end of March 2006.

9. Registration and Tuition Fees

(1) Registration fee: 282,000 yen
(2) Tuition fee: 267,900 yen for the spring semester (535,800 yen for one full year)
(Note 1) Registration fee should be paid during the registration procedures. Tuition fees should be paid separately: April for the Spring semester and October for the Fall semester.
(Note 2) Tuition fee for the Spring semester should be paid by account transfer from post office or bank using "Payment Request Form" which should be given in after enrollment. Payment from the Fall semester onward should be made by using the "Automatic Tuition Fee Payments."
For those who advance to second stage doctoral programs directly after completing first stage, account transfer payment of tuition (Tuition Payment Service) should be used from the Spring semester.
(Note 3) If tuition and other fees are revised at time of enrollment or while you are enrolled in our institution, the revised payment amount will apply from time of revision.

10. Other Points of Note

(1) If you have any questions about admissions to our Graduate School, such as application qualifications or documents and selection process, please inquire in advance at the office below.
(2) Before deciding which research group or professor/researcher's laboratory you wish to belong to for filing the application, be sure to contact the professor/researcher concerned.
(3) For details of research activities of professors/researchers, visit our website below.
(4) Since Nagoya University restricts vehicle entry on to the campus, use public transportation when visiting University for examinations.

Academic & Students Affairs Section
Graduate School of Information Science, Nagoya University
Furo-cho, Chigusa-ku, Nagoya City, Aichi Prefecture
464-8601
Tel. +81-52-789-4721
http://www.is.nagoya-u.ac.jp/
E-mail: admission@is.nagoya-u.ac.up

Nagoya University Graduate School of Information Science

● Outline

Recent information technology development has a profound influence in a wide range of fields covering human life, culture, art, science and economics. It has also changed our society greatly. The highly information-oriented society is under construction and is supported by both theories of information processing and communications. Today the world is going through a so-called information technology revolution, which demands fast and furious changes in social structure and social organization. In this modern society, it is acknowledged that “information” regulates how a society should be, and dominates human intellectual activities.

Information is a factor in human society which is as important as material objects and energy. In various fields of study, such as engineering, natural sciences, humanities, social sciences and arts, it enables us to recognize, understand and communicate modern society’s phenomena by abstracting their essence. Information technology is indispensable in all aspects of the planning, construction, and operation of systems in our daily life. It is also a technology with which to generate and identify, process and interpret, control and maintain information itself. Demand for social information technology is increasing constantly. Information science, which places information technology central to all information activities in humans, society and nature, needs to be prepared and developed, and society as a whole awaits its effect.

In our Graduate School, “Information Science” which integrated and collaborated different disciplines that had some relation with information supply needed to be promoted as a comprehensive discipline to respond to the needs of modern society. From the aspect of education, it is necessary to prepare an environment in which such human resources are nurtured, who could act as leaders and take responsibility for the construction of a discipline essential to the highly information-oriented society.

Taking these situations into consideration, it is necessary to develop specialists in the advanced information technology field, who can create a highly information-intensive society; to this end the Graduate School of Information Science was established at our university in April 2003.

● Degree

In the doctorate course (second stage) in our Graduate School, those who have completed requisite studies will be awarded the degree Doctor of Information Science. However, under certain circumstances, Doctor of Engineering or Doctor of Arts could also be awarded.

● Outline of Departments

Our Graduate School comprises the Department of Computer Science and Mathematical Informatics, Department of Information Engineering, Department of Media Science, Department of Complex Systems Science and Department of Systems and Social Informatics. In regard to the names and contacts of professors and researchers in respective departments, please refer to http://www.is.nagoya-u.ac.jp/

1) Department of Computer Science and Mathematical Informatics

Our Department conducts study and research in the basic domain of Computer Science including design, analysis and efficiency in information processing, as well as in the domain of Mathematical Informatics,, which aims to apply information-related domains through construction and analysis of mathematical models of various phenomena.

The nucleus of our Department consists of the basic domain of Computer Science including Algorithm Theory, Computation Theory, Logical Representation of Knowledge, Mathematical Science related to Information Science especially applications to study of algebra and its application to coding theory and cryptography, mathematical logic and computation theory, quantum computing theory, construction of mathematical models and research of numerical analysis, and the domain of probability analysis and its application to information theory.

In brief, in our Department, selected scholars are nurtured as highly specialized engineers and researchers in Basic Information Science.

Divisions	Outline
Basics on Mathematical Informatics Theory	Basics on Mathematical Informatics Theory is indispensable to encourage progress and fresh development of information science. In this course, education and research will be undertaken to solve mathematical problems including logical structure of information, algebraic structure, and the computer's basic features using mathematical methodology of mathematical logic, algebra, analysis, probability theory and statistics.
Information Mathematics Models	In this course education and research will be undertaken in the construction of mathematical models for phenomena in nature and society, which develop in terms of time and space as well as mathematical solutions on challenges related to mathematical analysis of generation, communication and accumulation of information. Furthermore, to realize these in computer-based work, mathematical and computational tools will be developed and analyzed.
Computing Theory	Education and research will be carried out on theoretical computer science which covers theory of algorithms and computational complexity as well as logic, semantics and programming. In concrete terms, the course covers graph algorithms, approximation algorithms, parallel/distributed algorithms, computational geometry and cryptography as well as formal models such as computational models, formal semantics and automatic theorem proving.

2) Department of Information Engineering

In this department, we study and research optimal hardware and software for user-friendly and secure information systems by using information engineering methodology. We concern ourselves with the design and development of such information engineering systems.
Furthermore, based upon the experience of study and research in our Department if Information Engineering, formerly in the Faculty of Engineering, which accommodating the remarkable development of semiconductor integrated circuit technology and information communication technology, we aim to create further developments in information engineering.
Through the development of semiconductor integrated circuit technology, compact size information systems and integrated systems are embedded in machinery such as home electrical appliances and automobiles. Such information processing machinery is, in turn, connected to a mega-sized information system, and can be used in the mobile environment. As a result the software architecture which underpins the information system being constructed becomes larger and more complex.
In this department, by providing education and study of principles and technology, which can be applied to the design and construction of information systems for the next generation, we hope to nurture specialists who will be able to take leading roles as highly advanced information engineers and scientists.

Divisions	Outline
Integrated Circuits and Systems	Integrated systems embedded in various devices such as home electrical appliances are used in daily life and demand high dependability and real-time property as well as severe constraint on cost. Its development indispensably requires co-design and concurrent design of hardware and software, and new development principles and methodology are necessary. In this course, education and study will be carried out in integrated system design, CAD, processor architecture and real-time operating systems, which are the nucleus of any integrated system.
Software Science and Technology	In constructing an information system, and having clarified the requirement of the system by analysis and specification, large-scale and complex software needs to be developed swiftly with precision. Furthermore, taking the advances of software and hardware technology into consideration, it is very important to propose and realize information systems that will be the bases of new social infrastructure. In this course, software science and technology will be studied in both theoretical and practical aspects to develop highly reliable and efficient software as well as to handle large volumes of data with precision, high speed and safety. In addition, in the mobile environment, we will study methods to enable effective use of PDAs (personal digital assistance) and means of information exchange between PDAs.
Information Network Systems	In the design of an information network that links various information processing devices composing information systems, we have to select the optimum equipment of communication from amoung various ones, and have to develop a communication method using it which enables efficient and secure communication. . We also have to develop algorithms, as well as methods for synchronization and communication between computing units, for effective computation on a computational grid. In this course, education and research will cover such subjects as organization of information networks, information security, intelligent information search, large-scale data analysis, ultra-distributed/parallel processing methods.

3) Department of Media Science

Information plays a major role in various human activities in industry, economy, society, education, art, medicine/social welfare, and the home. In such an information-based society, information needs to be produced and expressed swiftly with precision.
In this Department, we are in the core of the 21st Century "Intelligent Media (Speech and Images) Integration for Social Information Infrastructure"; it is necessary to collaborate with Center for Integrated Acoustic Information Research which aims to integrated comprehension of multi-dimensional acoustic signals from the viewpoint of multi-faced aspects such as signal structure, information conversion, linguistics, spatial physics and cognitive approach. Media science will be advanced as a trinity of basic science, engineering and cognitive science.
In this Department, our purpose is to study and research the basics of media science, the creation of intelligent machinery which process and express media, and to study ways to clarify the recognition function of human beings that are indispensable in developing a functional information society, and eventually hope to nurture competent media scientists and media engineers.

Divisions	Outline
Science of Speech and Images	Study and research will be carried out on mathematics of pattern information processing, image processing, sound signal processing, image space generation, speech/sound space generation, image recognition, speech recognition, natural language processing and multi-modal information expression. Through this study, we will be able to deepen our understanding of processing and by multimedia – speech and images – computation, the basic theory of multi-media information generation, methodologies of processing/conversion/recognition of multimedia such as speech/images, and express/generate information through multi-media.
Intelligent Media Engineering	In this course we undertake study and research on computer vision, computer audition, natural language generation, censor fusion, idea support technology, ultra-realism creation, intellectual human interface. Through such learning, we will be able to deepen our understanding of methodologies to realize intelligent media such as intellectual agents including intelligent recognizing machines, and intelligent robots' sensing that support various human activities such as design/medicine/ education/communication and its application to industry, medical welfare and education sector.
Cognitive Information Theory	In this course through studying research on integrated perception in a multi-modal environment, recognition process and memory of speech/language, its cause, process of discovery/creation, and language acquisition and understanding process, we will undertake research on the environment which is most effective for communication and creation as well as the method and system of language acquisition. This will in turn lead us to study further experimental and biological (brain/imaging) methodology, being an high-level cognitive process of human perception, memory, discovery and creation. Through such research, we will attempt to deepen our understanding by computer science methodology, its modeling, various functions such as human perception/recognition, memory, language and thinking and the unraveling of effects of human function modules and actual modeling. Furthermore, since audio-visual art such as fine art/music accounts for much of human life, we will continue our study into information processing/expression methodologies of human sensitivity, and seek the enlargement of sensitivity domains and possibility of creation, and emotional information search.
Information Media Space Organization Theory	Since it is indispensable to develop an information environment for supporting or enlarging human intellectual activities in fields such as education, research, development and art, it is necessary to undertake study and research on information media space organization which describes information via multimedia, enlargement and creation methods of the intellectual world, and organization methods of the multi-modal interface which facilitates communication with information space.

4) Complex Systems Science

Complex systems in nature and society comprise the network of many and varied elements such as molecules, neurons, agents which can communicate, convert and accumulate information, and which can therefore be understood as a distributive information system. A main feature of such complex systems is to generate dynamically and autonomously an order structure and function, which cannot be expected from the basic component's features.
Complex systems science, by deeming self-organization process of such order and function as information processing, aims to acquire a universal viewpoint. The objective is to investigate various natural and artificial systems and through synthesizing theories, experiments and computation methods, we will attempt to clarify the principle of universal information processing, which is hidden in varied objects.
In this course, we will study the development of innovative computation methodologies to analyze complex systems without using established reductionist methodology, but we will develop constructive method by "understanding by creating" model systems. By opening up distributive methodology which designs information systems based on self-organization of distributed elements, we hope to nurture engineers and scientists who are able to initiate new ideas through using organization theory thinking and distributive thinking.

Divisions	Outline
Multi-liberal System Information Theory	Complex systems in nature are autonomous cooperative systems that operate as aggregates in which many organization elements interact. To understand the information structure of such a system, it is important to understand the characteristics of the aggregates that interact among many groups with different degrees of freedom. In this course, we focus on communication, conversion and accumulation of information interacting among Many body systems and investigate new principles of information science from the viewpoint of information physics. Furthermore, obtained statistical results will be applied to the analysis of group information phenomena in nature and society.
Material Information Theory	Material base that assumes communication, conversion and accumulation of information in nature is movement, reaction and structure of its molecules and collective entities. This course aims to analyze the information flow in complex molecule phenomena, which is integrated and organized into function discovery, and by using simulation, Many body system, algorithm development and Non-equilibrium theory and plastic dynamics, principles that design and create, we will inquire into the creation of information function material, and carry out studies on material-based information processing. Furthermore, research will be carried out on innovative information technology related to the simulation of molecule systems such as the development of ultra-parallel computation and special computers for dynamics.
Life Information Theory	A living organic body comprised of molecules, cells and tissues shares information. It can be said that it is a distributive information system that communicates a lot of information for the mutual benefit of control and maintenance. Furthermore, its relationship is a hierarchical information system formed in a complex manner between matter and species. In this course, an organization/process related to communication, conversion, increase, and accumulation of wide-ranged life information is understood as dynamic change of bioactive natural product into various living molecules such as nucleic acid and protein, which will be clarified through experiments such as synthetic organic chemistry, bioorganic chemistry, molecular function analysis and molecular biology. Study and research will be in the field of new bioinformatics.

Divisions	Outline
Emergent Systems Theory	Emergent phenomenon comprise the core concept that characterizes complex systems. The emergent phenomenon is the autonomous emergence of information process function, information process structure and information dynamics, which are based on dynamic interaction among many components. In this course, we aim to educate and study the understanding and application of emergent phenomenon in complex systems. To this end it is necessary to inquire into emergent phenomenon information organization, which is based on the construction of a computation theory model, realization of complex systems simulation, and its verification and application in the real world. Thus we will study and undertake research into the establishment of new principles of information processing.
Complex Systems Computation Theory	Non-linear dynamic systems and activities that humans carry out in natural science such as production activities is accepted as complex systems, and by constructing a mathematical model, and by numeric simulation, the model is verified and optimized. This should help clarify communication, conversion and accumulation mechanisms of information in complex systems. Thus, complex systems including forecast and control/design methods as well as higher precision/high-speed solution is developed. This will lead to the construction of new information process principle/information process system and hence we will undertake studies and research into computer theory in complex systems informatics.
Information Visualization Theory	Setting physical phenomena and dynamic interaction which shows non-linear behavior as the objective, large-scale computation and high-precision measurement and analysis is carried out. We aim to construct complex systems informatics that can extract useful information from spatiotemporal phenomena. For example, to extract necessary information and clarify it from Flow system that shows complex behavior, or from various massive data in the interaction between ecology/environment systems and humans, visualizations, discovery science and knowledge processing will be studied.

5) Department of Systems and Social Informatics

In this Department, the social environment in which development of information technology enhances an information-intensive society, our research takes the viewpoint of physical matter/phenomena of the real world and fusion of logical objectives/processes. The study will be focused on environment, organization, and function which are cooperatively and complementarily fusion-capable and which are organized by the real world and virtual world that is superior for human society. Paradigm or model that fosters, creates and educates humans as well as that which is related to the construction of activity space supported by human wisdom and creative action is already established. Therefore, we would like to explore construction and architecture of a social system that is knowledge-dependent through the use of information technology, and for another, we would like to evaluate and consider the various problems that are generated in the social environment and social organization through the development of information technology. This will lead to research into the human role and organization of human society in an integrated space between the real world and virtual world.

In this course, from the standpoint of nurturing human resources that can meet the needs of the information age, we would like to raise for the awareness of the importance of information processing education, information technology development/application, functional design/development of social information systems, databases for social information environment, and development/construction of a user interface. Thus, we aim to educate competent personnel who can actively support and develop the information society.

Divisions	Outline
Knowledge Society system Theory	Human intellectual activities are supported by repetition of knowledge generation, refining, integration and fomentation, and each develops into new activities. In an information-oriented society in which knowledge is the basis, it is necessary to address any information model that assists human intellectual activities, knowledge control/management architecture and any social information system that claims to realize all these. In this course, from the standpoint of the fusing/matching of the real world and virtual world, we will study the knowledge-oriented society system that can most effectively assist human activity space. Furthermore, in the virtual space that develops in the information-oriented society, handling of intellectual property becomes an important challenge. It is necessary to secure quality intellectual property and its distribution. We will also study its management/application from a technological viewpoint.
Electronic Society Design Theory	Extended dissemination of the Internet and Intranet and its penetration into social systems has realized various mechanisms of the real world as in a virtual world. Accordingly human life space and social environment is being transformed on a large-scale. In this course, we will reconsider the system of the real society, and use information formation processes for the modeling of electronic systems. Furthermore, research will be on construction and design methodology of the social information system and its contents in the fields of education, administration, museums and images. In addition, taking into account communication system design in an electronic-intensive-dependent society, research will be carried out on information design and usability, visual literacy and public art that is linked to computerization.
Information Creation Theory	Approach to information, heretofore, focused on efficient communication of existing information, and its primary concern was the application of computerized information processes to individual sciences, and hence the standpoint taken was from that of basic thinking. In this course, to form an approach that goes beyond that, we try not only sending communication via information but also establishing various settings where information is to be created. While clarifying the common factor, we would like to delve deeper into the significance and value of what is happening and what it means for human life, through philosophical studies taking history of thought into consideration. Furthermore, we accept the problem of information ethics that takes place in the encounter between “pursuit of information communication efficiency” and “study of information creation”, aiming to expand such discussions.
Infrastructure Environment of Information-Oriented Society Theory	In environmental activities, which take place in the setting where virtual space and real space become fused, which is the result of an information-oriented society, actions which have different values from the one real world are constructing new situations. In this course we will explore the criteria for intellectual significance and value standards, which should be the role model of human action that is evolved in the information-oriented society. We aim to establish an organization that will lead to the creation of principles in information space and information environment design as well as a framework for intellectual systems. Our research will be on a social environment infrastructure system which is brought about by the formation of an information setting where use/management/construction of information is integrated, including situation recognition/comprehension/composition/distributive technology as well as social state infrastructure design, and semantics of expression of action. There will be instruction on intellectual artificial organization methods among humans who have interactive ability. This will lead to the nurturing of scientists and engineers who can create a social environment infrastructure that supports new communication styles.