

**ROLE OF SCIENCE AND TECHNOLOGY
CENTRES AND THEIR RELEVANCE
ON SOCIETY**

THESIS

*submitted in partial fulfilment
of the requirement for the degree of*
DOCTOR OF PHILOSOPHY

By

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Under the Supervision of

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**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE
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1999

**DEDICATED TO MY
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This is to certify that the thesis entitled **ROLE OF SCIENCE AND TECHNOLOGY CENTRES AND THEIR RELEVANCE ON SOCIETY** is submitted by **R.MADHAVAN I.D.No.94 PHX F401** for the award of Ph.D. Degree of the Institute, embodies original work done by him under my supervision.

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ACKNOWLEDGEMENTS

I am deeply indebted to **DR. M. SARGURUMOORTHY**, Executive Director, Tamilnadu Science and Technology Centre, Chennai for being SUPERVISOR for my Ph.D. Programme, for suggesting the Topic, Title & Completion of my research work, giving valuable guidance and providing the necessary facilities of this Centre.

I wish to express my sincere thanks to **DR. L.K. MAHESWARI**, Dean, Research & Consultancy Division, BITS, Pilani for having guided me to complete my Ph. D. Programme by offering many suggestions and useful discussions.

I am most grateful to **DR. R.N. SAHA**, In-charge, Ph.D. Programme who has shown very keen interest in my Ph.D. Programme from the beginning to the end.

I am thankful to **DR. M. BANERJEE, PROF. K. E. RAMAN, DR.R. MEHROTRA, DR. K.R. CHANDHOKE** and **PROF. M.K. KASHIRAMKA** as examiners during my Qualifying examination for evaluating my works.

It gives me great pleasure to express my gratitude to Late **DR.C.P.GOPALARAMAN**, former Executive Director, TNSTC, Chennai who had initiated & encouraged me to do this Ph.D. programme, by providing me with the facilities in this Centre and giving guidance at every phase of investigation without which I could not have completed my work.

I am also thankful to all staff members of TNSTC for their help & Co-operation.

I am thankful to all staff of BITS, Pilani for helping me to use their facilities in BITS' campus.

My thanks are also due to **Thiru. M.Parvathinathan**, Director, VITM, Bangalore, **Thiru. K.Madan Gopal**, Project Co-ordinator, Regional Science Centre, Tirupathi and **Thiru. S.Chandrasekaran**, District Science Officer, DSC, Tirunelveli for their kind co-operation during my visit and analysis of visitors at their centres.

I thank **Prof.Gunter Knerr**, Director of Deutsches' Museum, Munich, Germany for having guided me to work on the projects namely Material Science, Computer Science and especially on "Multimedia Ceramics and Glass."

I thank **Prof.K. Anbazhagan**, Our Chairman, TNSTC and Honourable Minister for Education, Govt. of Tamilnadu for allowing me to do my part-time Ph.D. work in this field on Science Centres.


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CHAPTER - I

I OBJECTIVES OF SCIENCE CENTRES

1.0 Introduction

Education provides knowledge to the people. People derive the knowledge not only from the formal usual education but also from the other media sources such as Newspaper, Radio, Cinema, Television, Exhibitions and Museums. As the present generation of the people are immediately in favour of adapting to the new developments in every fields, it is the utmost requirement expected from different sources to provide the quick knowledge about the various products of the fields such as Science, Technology, Economy, Agriculture and Environment.

One of the sources from which the above said benefit can be derived, is the modern concept of "Science Centres" which are existing in various countries of the World. In India, during the last decade, the Science Centres have been built and opened to the public for learning in an informal way. This thesis has mainly dealt with the role of such Science and Technology Centres and their relevance on Society.

The objectives of Science Centres are to develop interactive type of exhibits at Science Centres to help in widening the scientific outlook of the new generation, supplement the science and technology education imparted in schools and to make the students to understand and appreciate the impact of science and technology developments. This will strengthen quality of science education for all age groups.

Developed countries, like U.K., U.S.A., Japan, Germany, etc., infact make great use of science and technology centres or Hall of Sciences, as they are often designated with the well equipped and well organised establishment abounding in live and interactive scientific and technological exhibits fully arousing the built-in interest and curiosity of students.

The entire history of humanity shows that it is the scientific temper which not only created and promoted science but also gave humanity, the means to effect the natural and social environment. Science temper is the most precious heritage of humanity, which is the result of incessant human labour and search. It is compatible with observation and insight, reasoning and intuition, systematic work and creative impulse. The Science and Technology Centres are providing students with the opportunity to experiment and by the exposition of exhibits equipped in halls of Sciences and also to gain insights into the world of science and technology through interactive type of exhibits.

The education pattern refers to structural and graded education system which starts in primary schools. Education in schools is on syllabus, curriculum and limited time for evaluation through examination systems. The programmed knowledge acquired by the students in their class rooms generally does not bless them with the required vision and wisdom to tread through their adult life successfully. Knowledge and Creativity are to be imparted to the students through direct participation. The Science and Technology Centres would be effective vehicles to act as sources of interest and inspirations to the students in helping them to develop science thinking and keep their scientific fervour ever burning in quest of understanding and unravelling scientific marvels of the world.

THE NATIONAL EDUCATION POLICY - 1986 lays emphasis on cultivating the spirit of inquiry and a scientific temper in students. For this reason the special emphasis is given to strengthen Science teaching in Schools at all levels. The quality of Science Education needs to be raised, considerably.

Science is not learnt by reading the text alone. It is a known fact that students will retain science concepts better when they are engaged in experiencing the events. This can only be achieved through interactive type of exhibits.

To complement Science Education, Science and Technology Centres are essential because they provide educational facilities in the form of interactive exhibits and

specialised equipments such as lasers, computers and other modern equipments, to students which schools do not or are unable to provide due to financial constraints. An unique feature of Science and Technology Centre's approach for complementing school programmes lays emphasis on first hand observation by the students and direct experience in science and mathematics besides the school curriculum.

The Science and Technology Centre encourage the students in learning science through interactive type of exhibits, thereby bridging the gap between the facilities available at their schools and what is needed to be learnt.

The Science and Technology centres are effectively training the teachers based on their needs and thereby motivating them to impart science learning by the students in an interactive manner. This will definitely derive benefit to the students through the training programme of teachers.

Key - Role of S&T Centres

Science and Technology (S&T) are the two important and inseparable attires for the modern men, women and children in the 21st century era. Now-a-days New developments in the field of Science and Technology have been immediately absorbed and adapted by the different sections of the world. In order to feed the information about these developments, one has to devise some means for bridging the gap between the man and the source of intelligence. The gap can be narrowed down by creating a perfect market of selling knowledge from where the people from different fields can derive the benefits. When knowledge combines with culture and spirituality, a balanced society is evolved. For a perfect market of a balanced society, sellers and customers are needed. The customers are to be satisfied by the sellers. Similarly, in case of percolating the knowledge of Science and Technology to the people (customers), Science Centres (Sellers) play a key role in selling the knowledge of Science to the needy sections of the people of the country.

Science Centres - as a Knowledge Store

A Science Centre is a place of knowledge where the exhibits depicting the principle of Science and Technology are displayed with the necessary labels. It also provides good environment and surrounding for learning with freedom of thought and questioning. As per the chinese proverb,

I read, I forget

I see, I remember

I do, I understand,

the last phrase applies directly to science centres because they provide the interactive exhibits on science and technology (S& T). The visitors from all walks of life work with their hands on the exhibits and learn the scientific principles behind the exhibits. That is why, the exhibits are called as "Hands -on exhibits".

The Science Centre expects the visitors to work on the exhibits and learn as much as they can. It is for the visitors to measure & utilise their opportunities. Visiting Science Centres is an opportunity which every citizen of the nation should utilise. Otherwise the opportunity cost by not visiting Science Centre will be an added burden for the people because they have not availed this in their life time. The effect of realising the importance of Science Centre is being assessed in India during the 19th century. Due to its actuation, many Science Centres have been built in different parts of India. One among them is the Tamilnadu Science and Technology Centre (TNSTC) established by Govt. of Tamilnadu Situated in chennai near Gandhimandapam amidst many research and educational institutions.

Comparative Analysis

The idea of my thesis is to analyse the present Science Centres of India for the reaction of the people on Science & Technology Centres of different geographical locations; on S&T exhibits; on Learning styles of the visitors and on Organisation structure, Growth opportunities for employees and their effect on motivation of employees.

The methodologies adopted in evaluation and assessment for the above are Questionnaire and Interview methods. A brief outlook of the different science centres is explained below.

National Council of Science Museum (NCSM)

The National Council of Science Museums of India has built many science centres of three different kinds. They are National Science Centres, Regional Science Centres and District Science Centres. The list of the Science Centres of the above three kinds are given in Appendix No.4. The major science centres are Nehru Science Centres (NSC), Bombay; Birla Industrial and Technological Museum (BITM), Calcutta; and Visvesvaraya Industrial Technological Museum (VITM), Bangalore. The details of the Science Centres of NCSM are also given in Appendix No.04.

NCSM has also recently established a Science City near Salt Lake, Calcutta which has a tiled dome Planetarium and IMAX theatre.

Tamilnadu Science and Technology Centre, Chennai

TNSTC has established Periyar Science and Technology Centre in its campus. This centre has a modern Planetarium with 236 seats, Interactive Science Exhibition having seven galleries on S & T and Outdoor exhibition parks such as Science Park, Traffic Park,

ECO Park, Meteorological Observatory surrounding the Planetarium. The campus has facilities such as a souvenir shop, canteen, water closets and bathrooms for catering to the needs of the visitors. The halls of science are Transport, Energy, Materials Science, Life Science, Innovation, Electronics & communication and Physical Science. In addition to the above, for a change, a Play Pen and an International Dolls Exhibition Enclaves have been established to entertain the visitors, especially children. Also a Museo bus has been used for mobilising science on wheels in rural areas. So far from the inception, over 26 lakh persons have visited this science centre.

This centre has also inaugurated a Regional Science Centre namely Anna Science Centre at Tiruchirappalli on June 10, 1999 by Honourable Chief Minister of Tamilnadu. This included a 80 seated Computer Controlled Planetarium and Science Park.

1.1 Composition of Thesis Study

The Thesis has been divided into four main parts. Part I deals with the review on S&T resources for society and the interaction study between the S&T centres and the society (TNSTC). Part II is to study on the status of S&T centres and to present the datas on various aspects of the S&T centres. Part III is to study on Science Centre in terms of their formation and establishment of thrust areas in S&T field such as Materials Science and Computer Science towards the Societal benefits. Part IV deals with the evaluation and assessment of the reaction of visitors on Science Centres of NCSM with special reference.

Part I

The first part involves the review on S&T resources for the society and the collection of primary data from various S&T organisations and Centres on various themes such as visitor's learning styles and organisation structure. The methodologies adopted for the above task are through practice lecture series, independent study using seminars, questionnaire and interview methods. The S&T resources taken for this study are such as solar energy, Microelectronics, Teaching Aids, Environment and water conversation and management.

Part II

The second part deals mainly with the secondary data collection on various Science Centres of India and Abroad. This is to compare the past and Present activities of S&T Centres and to predict the shape of the future S&T Centres.

Part III

The third part is to study on Science Centres in terms of their formation and establishment of thrust areas in S&T fields such as Materials Science and Computer Science towards the Societal benefits. Thus it deals mainly with the core thrust areas of S&T and their developments. The two thrust areas such as Materials Science and Computer Science are given importance. In addition to this, Multimedia Ceramics and Glass have been also incorporated for the development of Modern Science Centre.

Part IV

The fourth part is to study on the evaluation and assessment of the reaction of the visitors of various Science Centres. The collection of primary data from various S&T centres are on various themes such as visitor's learning styles and organisation structure. The methodologies adopted for the above task are through questionnaire and interview method.

Conclusion

The Concluding part highlights the expected outcomes from the above studies towards relevance on Society. It is inferred that the benefits accrued from the developmental role of S&T Centres by the society are immense and innumerable. They have been enlisted in the concluding part of my thesis.

A LIST OF MAJOR OBJECTIVES OF SCIENCE CENTRES

1. To spread and popularise S&T among the general public in the rural and urban areas by setting up Science Centres in different parts of the country.
2. To create awareness for the general public and the students about the basic principles and developments in S&T mainly through interactive exhibits.
3. To supplement and complement the formal science education imparted in schools and colleges
4. To train teachers in developing teaching aids for science instruction with a view to improve the quality of School Science Education in the country.
5. To undertake Scientific Research in the areas of S&T including Museology and Astronomy.
6. To provide research facilities for pursuing basic and applied research.
7. To organise Seminars, Science Exhibitions, Science Camps, Popular Lectures, Training Programmes, Workshops for Science Teachers, Students and General Public.

CHAPTER - II

II PART - I

REVIEW, EVALUATION & ASSESSEMENT OF SCIENCE CENTRES

1.0 REVIEW ON SCIENCE & TECHNOLOGY RESOURCES FOR SOCIETY

Introduction

The aim of the studies is to evaluate the status of knowledge on Science and Technology which have reached the Society and to assess the improvements required for percolating Science and Technology awareness amongst the society. Towards the achievements of the above goal, the resources available in the field of Science and Technology such as Policies, Planning and Budgeting, Appropriate Technology, Meteorology, Conservative Techniques, Popularising activities from the publication to the Establishment of Science Centres, etc., have been studied and analysed. The Study on Scientific knowledge required for Human Resource Development (HRD) which is the burning problem in our country, have been given much importance. In this connection, to begin with, the series of journals on Society and Science of Nehru Centre, Bombay have been perused and analysis made on Societal expectations from renowned Scientists and Scholars.

Societal Expectations and their Implementations

The expectations may be different for various sections of the people such as rich, middle and poor. As our aim is to cater to the needs of the weaker sections of the society, their immediate expectations may be eradication of poverty, provision of adequate food, nutrition, clothing and shelter, better opportunities for health and education, Industrial

Development /1/. The developments in Science and Technology have to fulfill the above expectations of the weaker sections. For this, the weaker sections have to understand the knowledge of Science and Technology to enjoy the fruits of the advantages of Science. Basically an Information is itself a knowledge. But it has to reach the people. Hence, the information when based on observation and experiment, tested critically, systematized and brought under general principles becomes scientific knowledge /2/. It is not always possible to achieve all the requirements of the expectations of the society, due to various constraints such as lack of resources, man-power and machineries.

In order to remove the constraints, proper Scientific and Technological cooperation among the Developing countries may have to be established to create the required resources to strengthen the Human Resource Developments of the country. The international co-operation between Science and Technology against technological colonialism has to be built-in amongst the friendly countries. Scientific, Technical and Economic Co-operation must be based on equality, respect for national sovereignty and mutual benefits /3/.

There are some barriers for the lack of Science and Technology Cooperation between nations. They are,

- (1) Strained Relations
- (2) Militarisation of developing countries
- (3) Forces which encourage Technological Colonialism.

The possible solutions for these problems are :

- (1) Conducting regular Science and Technology Conferences, Meetings and Symposia on specific problems which are of common interest in developing countries.

- (2) By the establishment of international and regional Science and Technology Societies and Associations.
- (3) To combine Science and Technology Libraries of a number of countries with in a region with an international Inter - Library Network.
- (4) Multilateral cooperation.

Study on Availability of Resources

As the societal expectations from the Scientists and Engineers of the country are in great demand compared to their limited implementation processes, it is highly essential to search for all available resources. Some of the major resources are as follows:

- (1) Policies, Planning and Budgeting
- (2) Appropriate Technology
- (3) Meteorology
- (4) Conservation Techniques
- (5) Wealth from Waste resources
- (6) Biological Science developments
- (7) Popularization activities from the publication to establishment of Science Centres

1. Policies, Planning and Budgeting

While dealing with the viability of a proper policy and planning of Science and Technology for Society, in a selected city Chennai the following four phases have been prepared by the author /4/.

- (1) Plan formulation - within a long term perspective that is 20 to 25 Years period.

- (2) The need for National plan for Science and Technology with an intermediate perspective, say at the end of 10 years.
- (3) Formulation of Successive national indicative plans.
- (4) Formulation of research programmes and projects at both an institutional and sector level for the plan duration.

2. **Appropriate Technology**

Among the many technological resources, the most important resources for the immediate needs of the society is the Appropriate Technology which is being given much attention by our government. Most of the planners and Managers of large, middle and small scale industries have given indepth involvement of human beings.

The appropriate technology as an alternative choice of technology is studied under the prevailing conditions of energy crisis and shortages in Agricultural products. The criteria of appropriate technology are:

- (1) To reduce inequalities in economics.
- (2) To meet the minimum needs - employment /5/.

The employment criterion is due to the packed technologies made by the developed countries for the developing countries. Thus technologies replace the bonded labourers of our society by machines.

In adopting the appropriate technology and utilizing their own raw materials with minimum imports, the developing countries will become self-dependent. Hence caution is given to developing countries to adopt appropriate technologies for reducing the danger of depending on other countries.

3. Meteorology

The applications of Meteorological principles which govern the control of pollution from an industrial plant in the selection of its location, in its design and equipment and its day-to-day operation are important resources for the development of healthy society. The people should be freed from the diseases such as ulcer, cancer, cholera etc, arising from the dusty pollution created by transport effluent from the vehicles, poisonous gases emitted from the industrial Chimneys etc. In order to make the people free from the clutches of the pollution, the meteorological resource measures may be incorporated in the vehicles, industries and institutions /6/.

4. Conservation techniques

The most important saving of resources is that of conservation process. This has to be motivated amongst all the levels of people living in our society. This has to be even adapted from the house to institution and to large level industries. Conservation of Energy is very important aspect to be realized by every citizen of our country. Late Prime Minister Smt. Indira Gandhi has enunciated the energy strategy for the three range of periods as follows /8/.

In the short term, it is to reduce the consumption of oil and increase efficiency in the use of economy. In the intermediate range, it is to supplement oil with other primary forms. In the long term, it is to develop Nuclear Power, Solar and Wind energy, Bio - mass and other Renewable sources and to conserve fossil fuels.

5. Wealth from Waste Resources

Wealth can be generated for the society not only from the usual methods but also by means of reducing the wastes (conserving the resources to the required needs) and utilizing the waste to produce new things which are useful to the mankind. In this context, the society should realise that in the near future, scarcity of energy and dearth of

materials will threaten our non existence. In Industries, it is also possible to increase the productivity by optimization of various technological and management inputs. The author has also reiterated that 6000 million tons of topsoil is washed away per year /8/. Such a galloping Deforestation may be counteracted by fast growing species for Reforestation.

6. Biological Science Developments

Biologists and Scientists in this field have carried out their researches in relation to the ethics and society. The resources and outputs from their research are mainly to safeguard the rights and integrity of the humanbeings or an individual and of an acute sense of their responsibility towards society. The biologists have made tremendous advances made in the Life Sciences have also implications in the key areas such as dangers of pollution, preservations of ECO system, agricultural development to avoid food shortages, measures to counteract the stress and tension of life, world population growth and its control /9/.

7. Popularisation activities

Eventhough many developments have been made in Science and Technology, they have to be understood by the members of the Society. For this proper Popularisation resources have to be created to permeate the new tools of thought represented by Science and technology /10/. A people's science movement has to be created in every states of India. This has been tried out in Kerala. The output is tremendous towards the improvements in literacy and economic life. In Kerala, the activities such as publications, non-formal educational classes, study classes, Science forums in the villages exhibitions, Science marches and campaigns, Science Centres for dissemination of Science and the in-depth study of rural problems, short-term courses and contacts with agencies have been carried out to improve the literacy and economics of life /11/.

Summary

From the above indepth study on the Science and Society aspects especially in relation to the resource requirements for assessing awareness and for evaluating the quantum of knowledge on Science and Technology, it is crystal clear that the developments in Science and Technology for the society should be for peaceful purposes. The misuse of Science should be avoided for the benefits of humanbeings. For example, the bio-medical development like the Ultrasound scanning equipment must not any longer be allowed to be used for telling the sex of a baby before hand. This is because of fact that apart from ethical considerations, wide spread female foeticide may in the long term, create serious imbalances in the sex ratio and have catastrophic consequences to society. We need to develop science to stop misuse of science. These types of awareness ranging from the understanding, mastering, and the purposefulness of Science for peaceful activities have to be born in mind by the citizens of the country while analyzing the Science for society. Finally, an effective interface has to be abridged between Science and Society. This can be achieved only by creating the infrastructure such as modern concept of Science Centres or Science Museums where the society will be brought nearer to the uses of Science, by means of interactive exhibits on the various fields of Science and Technology.

1.1 HARNESSING SOLAR ENERGY

DESCRIPTION

Introduction :

Sun is the only source of energy (Solar Energy) from which all the energy on the earth is derived. Solar energy is clean and a perennial source. The solar energy is captured in the form of the solar power, hydro-power and wind power. The energy from the sun can be used in meeting the energy requirement in almost all the temperature ranges.

Our energy problem in principle could be solved if Society exploit a small portion of the solar radiation that strikes the earth's surface every year which is $1,78,000 \times 10^{12}$ watts. This solar energy is equivalent to 15,000 times the world's present energy supply.

The solar energy is spent as follows : 30% of it has been reflected back to space, 50% are absorbed, converted to heat and radiated, 20% of the solar energy creates wind, powers the water cycle and drives photosynthesis process. One simple example will highlight the harnessing effect of solar energy. (i.e.) one square metre of direct sunlight passing through a clear-glass window can illuminate 200 square metres of floor space (i.e) 1 : 200. / 21 /.

The major components :

- 1) Solar Energy Details
- 2) Direct Solar Energy System
- 3) Indirect Solar Energy
- 4) Applications of Solar Energy
- 5) Uses and Benefits
- 6) Cost Factor
- 7) Working Function of Photovoltaic cell.

Direct Solar Energy System

- 1) Photovoltaic electricity from silicon solar cells
- 2) Solar Thermal
- 3) Solar Pond Power Plant
- 4) Solar Furnaces
- 5) Solar Water Heater
- 6) Solar Cooker
- 7) Solar Power Scheme or plant
- 8) Solar heated Exhibition Building
- 9) Solar refrigeration system
- 10) The Dish - Stirling Engine Solar Electric generating system
- 11) Line focus distributed collector system

Indirect Solar Energy System

- 1) Biomass based power generation system
- 2) Miscellaneous indirect stations
 - a) Small hydro-power stations
 - b) Ocean thermal energy conversion (OTEC)/23/.
 - c) Electricity Generation from Wind-Farms.

Some of the Direct Solar Energy Systems are explained below.

1) Photovoltaic Electricity

The electricity generation is realised directly from the sunlight. Photons (individual particles of light) from the Sun's rays are absorbed in the semiconductor. These photons create an electric current. The advantages are the Quintessential energy source, creation of electricity with no pollution, no noise and often no moving parts. Photo-voltaic (PV) Electricity needs minimum maintenance and needs no water. PV is well suited for remote

or arid regions. It operates on any wattage (i.e.) from multiwatt to multimegawatt. It has a flexible size (i.e.) suitable for rural areas. It allows the systems to be located nearer to the users. The power efficiency is 12%. A 40 sq.m. array produces sufficient electric power, consumed by a typical household.

Mechanism of a Silicon Solar Cell

The schematic diagram shown in Fig. 1 explains the different cases involved in the generation of electric current. Consider a silicon wafer sandwiched by a p-type material and a thin layer of n-type material of silicon. There are four conditions to be considered regarding the process of generation of electric current/22/.

Case : (a)

When photon of appropriate energy penetrates the cell near the Junction, it encounters a silicon atom. Due to this, it dislodges one of the electrons which leaves behind a hole. The electron migrates to n-type layer. The migrated electron travels to current collector and generates an electric current in the external circuit. The same electron again reappears in the layer of p-type and recombines with the waiting hole. This completes the cycle for one photon. Likewise, many photons impinging on the silicon layer create electric current and are summed up to a higher electric current in the external circuit.

This is true for the photons which have appropriate energy which is equal to energy band gap. Let us consider other energy level photons.

Case : (b)

When the energy level of photons is greater than the energy band gap, this photon generates electricity as explained above but generates excessive heat. Hence the amount of electricity generation is very less comparison with the heat generated. Hence the efficiency is low.

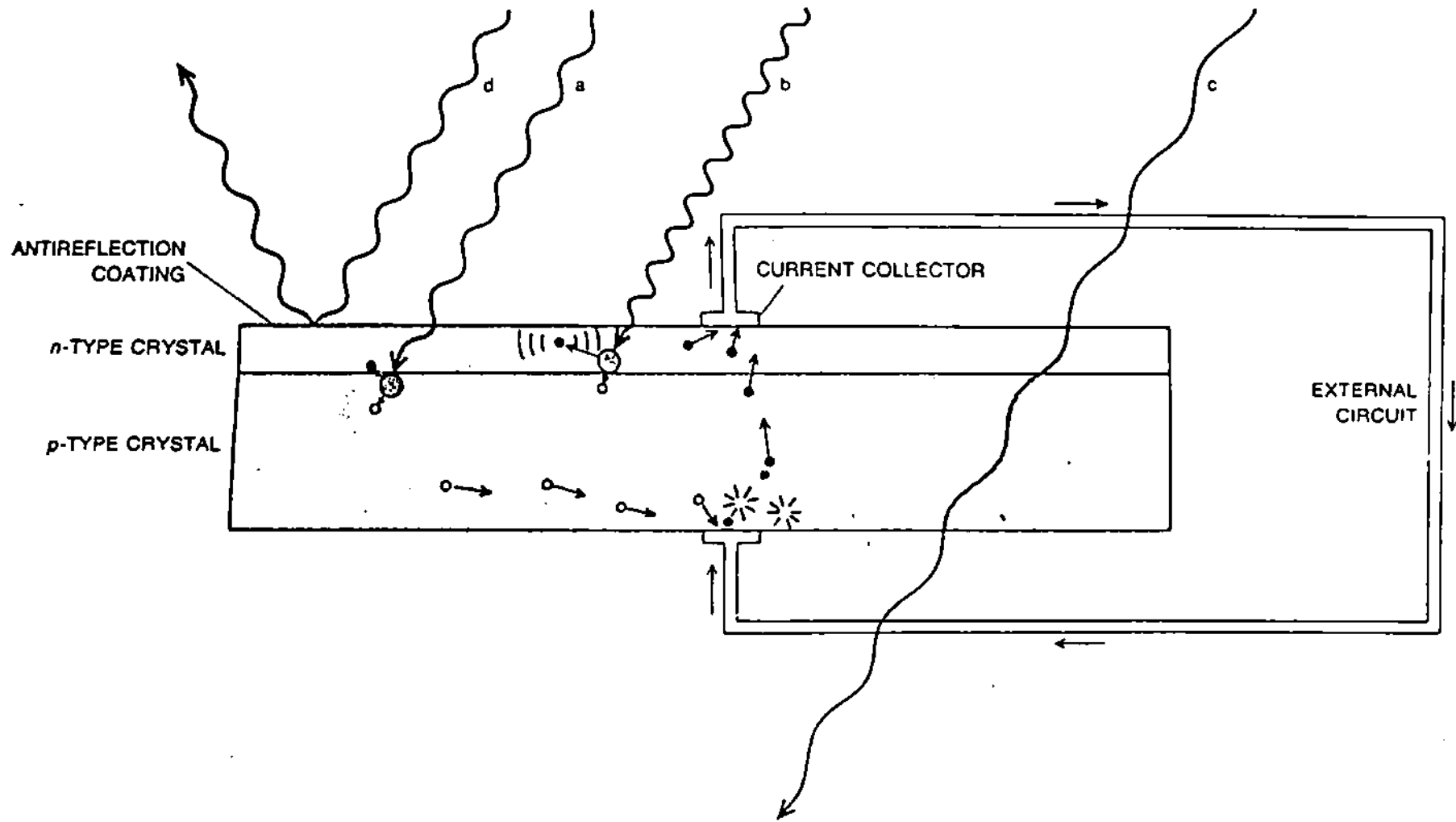


Fig.1. Mechanism of a Silicon Solar Cell

Case : (c)

When the energy level is less than the energy band gap, photon passes right through the cell with no encounter with silicon atom. No generation of electric current is possible.

Case : (d)

Some of the photons are reflected back, due to anti-reflection coating on the cell.

2. Solar Power Plant : Power Station in orbit

Here the power station has been fixed on a orbiting satellite by installing the power station on a Geo-synchronous satellite which is located 36000 kilometres above the equator. The satellite station will look stationary for an observer on the earth or the receiving station on the ground. A 10 gigawatt of power station envisaged for New York City has been contemplated in U.S.A. The details of the orbiting station and the receiving station are as follows :

Orbiting Power Station

Solar Panel Size	:	8 km x 8 km
Radiant Solar Power	:	8.5×10^7 K.W
Efficiency of Solar Cell	:	18%
Available electric Power	:	1.5×10^7 K.W.

This electric power is proposed to be converted to Microwave radiation and beamed to earth station.

Receiving Ground Station

Size of Receiving Antenna	:	15 Sq. Km.
Cost of the system	:	500 \$ per / KW which is 2 times that of Nuclear Power Plant.

The wavelength of Microwave is such that it penetrates the cloud with negligible loss.

3. Solar Heated Exhibition Building

Solar Panels can be used to heat water for homes. They are usually mounted on the roof. For example an Exhibition Building is heated all year round by a 100 m² water heat store. Water is passed, under double glazing, over the black corrugated aluminium roof, heated by the Sun and stored in the well-insulated heat store. Water is pumped through under floor heating pipes as required. The thermal performance of this building is being continuously monitored.

4. Solar Furnace

In the above method of solar heated building, solar energy is not concentrated but distributed, hence the heat may not be sufficient for industrial processes. The commonest way of concentrating solar energy is to use a mirror curved into parabola. This reflects as the light rays coming from the sun into a very small area so that the combined effect produces a high temperature. Parabolic mirrors need direct Sun light to work and are good for use in tropical countries where they are used to cook food.

Example : A huge parabolic mirror is used as a furnace in a mountain in France where it reaches temperature of about 4000 deg. C.

Solar Water Heaters

Here, the glass surface traps energy directly from the sun. The heating capacity is from 100 litres to 1.25 lakhs litres/day for the temperature $t = 60$ to 80 deg. C. The required glass surface area is from 2 to 3 sq. metres of collector area for 100 litre capacity. This is increasingly used in house-holds, industries and other establishments. This Solar Water heating method is also used for desalination plant.

Solar Cooker

It comes under solar thermal applications. It saves 2 kgs fuel wood/day for a regular use of a standard family. The solar cooker is used for community solar cookers for serving midday meal schemes. In our country it is quite popular in Rajasthan.

Solar lighting PV panels for Solar pumps

The solar pumping of water for drinking purposes have been incorporated in villages. This used solar PV panels of 450 to 800 watts of power for motors for pumping out the water from the wells in the rural areas. It is also used for minor irrigation purposes. The PV panels are used for street lighting and domestic lighting. They can operate a community Television unit. Small voltage level solar cells are used in wrist watches, calculators etc.

Solar Refrigeration

There are two methods of solar refrigeration.

- (1) Vapour absorption refrigeration system : This utilises low grade thermal energy obtained from flat plate collectors. This replaces conventional compressors.

- (2) Concentrating (focussing) collectors to supply heat at a higher temperature to heat engine which then drives the compressor of a conventional refrigerator.

Solar refrigeration with an absorption system is better way of direct utilisation of energy. The vapour absorption system replacing the compressor by a generator absorber assembly can work with a wide range of absorbents and refrigerants. Here motive power is very small. Solar refrigeration method is mainly intended for food preservation, that is, storage of biological and medical materials.

Conclusion

There are innumerable applications of solar energy. Some of the applications are Heating and Cooling of Residential Buildings, Solar Water Heating, Solar Drying of Agricultural and Animal products, Solar Distillation - Desalination plant, Solar cookers, Salt production by evaporation of sea water, Solar engines for water pumping, food refrigeration for preservation, Bio-conversion and wind energy, solar furnaces, solar electric power generation by (i) solar ponds (ii) steam generators heated by rotating reflectors (iii) reflectors with lenses and pipes for fluid circulation, Solar PV cells and power plants.

The society should take advantage in tapping solar energy and try to supplement this energy for our energy requirements.

1.2 MICROELECTRONICS

BRIEF DESCRIPTIONS

01. Introduction

Present day Science and Technology advancements are calling for electronic devices containing hundreds or even thousands of components combined in a single circuit by as many connections. The world expects a drastic reduction in the weight, size, power drain and cost of these devices, along with enhancement in their reliability.

Search for a solution to these above problems led to the advent of a new dimension of electronics, namely, Microelectronics which is a miniaturisation electronics. Another point to be stressed is that this microelectronics is a fast developing and changing area internationally and has a larger global economic impact due to reliable and increasing device density.

02. Microelectronics and its Directions

The following five directions in Microelectronics have been presented/30/.

- a) Thinfilm
- b) Hybrid
- c) Semiconductor
- d) Monolithic
- e) Large scale and very large scale.

a) Thinfilm: These are fabricated by applying to a substrate alternate layers of thin films acting as resistors, capacitors, controlled circuit elements. A substrate is the base material or core of a microcircuit used for physical support and may be passive such as glass or active such as silicon.

b) **Hybrid** : Passive components and connections are made as in film circuits. Active components are discrete semiconductor devices.

c) **Semiconductor** : These are fabricated within the bulk of a Semiconductor by injecting different impurities locally.

d) **Monolithic** : Active components are fabricated within the bulk of a semiconductor material, while passive components and main connections are made applying films to its protected surface.

e) **Large Scale** : These are semiconductor circuits each performing a specific and self contained functions, which cannot be divided into individual components.

03. **Fabrication Methods of a Transistor Integrated Circuit**

The methods such as Masking, Etching, Diffusion, Oxidation and Interconnections are involved in the fabrication of I.C. transistor.

04. **Developments in India**

- a) CEERI - Central Electronics Engineering Research Institute, Pilani, Rajasthan/27/.
- b) Semiconductor Complex at Chandigarh.
- c) Bharath Electronics Limited, Bangalore.

05. **Conclusion**

Historical evolutions of Microelectronics from 1971 to 1995 are from U.S.A. - Intel's 4 bit microprocessor chip to the present PENTIUM 80586.

1.3 DIGITAL ELECTRONICS

BRIEF DESCRIPTION

01. Introduction

The Electronic systems based on the binary logic (either zero or one level) are usually referred to as Digital Electronics. These devices are used in a rapidly expanding range of applications in electronic calculators and computers due to their compatibility and speed. Basically Electronic system consists of two types, namely (1) Analog system and (2) Digital system.

Analog system is a linearly and continuously varying signal. Whereas, Digital system is composed of discrete signals. The signal contents will be different while their levels will be either zero or one/25/.

02. Number system

There are many number systems practised during the developments of mathematics. The basic number system we follow, is Decimal (ie) 0 to 9. Its base number is ten. Similarly we have binary, octal hexadecimal systems.

Binary system determines only the two logics (ie) Zero or One. It is simpler to represent any number in binary system due to its readability and recoverability. Its Base value is only two. Binary number system is the only one utilised in Digital Electronics.

Hexadecimal number system is used to represent larger decimal numbers in a short form. Most of the memory capacities and locations are indicated by hexadecimal addresses. For example, 1K byte of memory capacity is equivalent to (0000) to (03FF). Like this, one can address the different pages in the memory. So hexadecimal system is mainly used for memory mapping the softwares developed for the particular computer systems.

Thus the number systems play a vital role in applications of digital systems. It is possible to use all the other base system but they are not having flexibilities as that of binary and hexadecimal systems due to their easy representations and conversions.

03. Digital Circuits - Their classifications

The three broad classifications of Digital circuits have been discussed/29/.

- a) **SSI (Small Scale Integration)**
 - Logic gates and Flip - flops.
- b) **MSI (Medium Scale Integration)**
 - Address counters, shift registers, Number generators Multiplexers and Demultiplexers.
- c) **LSI (Large Scale Integration)**
 - Memories, Microprocessors, Digital clock, calculators, Games and Special purpose circuits.

04. Digital Logic Families

There are two types; one is composed of resistors, diodes and transistors; the other is that of MOSFET of P-Channel, N-Channel and C mos. DRL, DTL, TTL, ECL all belong to first type while P-Mos, N-Mos and C-Mos belong to second type/26/.

Among these families, TTL (Transistor - Transistor Logic) family is highly used in systems for its simplicity and lesser cost. TTL family has 5 distinct series such as LS, L, S, H and Regular depending upon their power dissipations.

LS	(Low power Schottky)	=	19 PJ
L	(Low power)	=	33 PJ
S	(Schottky clamped)	=	57 PJ
H	(High power)	=	132 PJ
R	(Regular)	=	100 PJ

The selection of TTL of above five types depends upon the usage of TTL circuits under different environmental conditions/24/.

05. Applications

There are innumerable number of applications of Digital circuits. They can be in building gates, flip-flops, counters, shiftregisters, mux, demux, clocks, processors etc. Now the trend in the design is to streamline the different systems so that functional systems such as microprocessor, digital clock, calculator, electronic games and special customer made circuits can be developed/28/.

During the past decade, Digital computers have been vastly developed. Softwares have been developed for these computers. Before the discovery of Digital computers, analog computers had been in use in Industries for process control operations. Presently, Digital computers are used and have replaced totally analog computer system.

1.4 EFFECTIVE UTILISATION OF TEACHING AIDS

BRIEF DESCRIPTIONS

1. Introduction

The effective Utilisation of Teaching Aids comes to the people when they need to use them for their basic requirements. For example, in case of low vision children, optical aids will be of much useful to them in addition to the prevailing non-optical aids. As per the proverb, "Necessity is the mother of invention", the teaching aids become a necessity for their living. Improvising teaching aids are the ones constructed from materials not intended or cared for the purpose. Their effective use lies in the making of charts, models and exhibits/34.35.36/.

The present technology development in preparation of teaching aids for different mass media such as Teaching, Radio, Print, Television and Exhibits are also discussed.

Visual aids :

There are two types of visual aids for low vision children /31/.

- 1) Optical aids
- 2) Non-Optical aids

i) Optical Aids

The most commonly and frequently used optical aids are Microscope and Telescopes. Microscopes are meant for a wider viewing field but a short working distance. Whereas the telescopes give a larger working distance but smaller field of view. Both the Microscopes and Telescopes are handheld or mounted or fitted into a pair of spectacles. They are helpful for children of low vision in class rooms. Handheld magnifiers, Folding magnifiers, Pocket magnifiers, Stand magnifiers, Illuminated magnifiers, Spectacles, Bar magnifiers, Telescopes and CCTV are also discussed/33/.

ii) **Non-Optical Aids**

They are useful for the near sight with ease applications. They can be used with light, lamps with fluorescent light, filters, pin-hole frame, slide, dimmer, tints, large print books, cassette recorders, felt pens, mobility aids etc.

Improving Teaching Aids

They promote learning by actual participation. Improvise means that are constructed from materials not intended for the purpose. Thus, the improvising teaching aids are prepared with inexpensive simple materials, by involving the children and the artisans. Simple materials like empty match boxes, fused electric bulbs, cans, seeds and shells, cycle forks etc. may be used for this purpose. Here teachers are the key persons involved with the children/32/.

Major contributions for preparing improvising teaching aids are :

- a) Nature of subject and inadequate learning
- b) Inadequacy of funds and general conditions
- c) Facilities for the use of aids
- d) Place of teaching aids in learning

2. **Utilisation of Teaching Aids**

Teaching aids are utilised when

1. Curriculum heavily loaded
2. Not able to complete syllabus
3. Concept not able to understand

- Ex :
- a) Expansion of metals on heating waste materials like spokes, blades
 - b) Concept of multiplication by broomsticks

3. Modern Teaching Aids

The major divisions are Print, Radio and Television. Under print media, Books, Newspaper, Magazine and House Journals are all available as teaching aids. Similarly, in Radio, one can have musical language, historical events as teaching aids. In Television, the programmes on Education such as UGC, IGNOU, QUIZ are used for teaching.

Present trend is in telecommunication aids such as Computers, Teleconferencing, Exhibits and Other Telecommunication devices such as telephone, telex, fax, satellite communication programmes/37/.

1.5 OUR ENVIRONMENT

BRIEF DESCRIPTIONS

1) INTRODUCTION

Environment is the sum of all external conditions and influences which affect the life and development of all organisations. The characteristics of our environment, study on Environmental system in terms of organisms, social and cultural factors and human impact have been discussed in this section. Human influence on Environment, Managing the garbages and social wastes have been described and explained with suitable examples/38/.

2) CHARACTERISTICS OF ENVIRONMENT

The Changes and actions are the two main parameters in the environmental characteristics. The change is composed of fundamental and natural ones. Some of the fundamental changes occur rapidly while others take place over many years. But the natural changes in environment follow a regular pattern and their occurring sequences are predictable/39/.

The actions of these changes tend to create more than one effect. For example, the burning of fossil fuel like coal, oil, natural gases etc. changes the atmosphere, causes the acid rain and adversely affects our health.

3) ENVIRONMENT SCIENCE

It is the Environmental system as per the followings :

- 1) Study of Physical and Biological environments of organism.
- 2) Social and Cultural factors
- 3) Human impact on the Environment

4) ENVIRONMENT AND ITS VALUE

The value of environment is not merely a piece of real estate. It is heritage for future generation.

5) ENVIRONMENT AND DEVELOPMENT

The development of Environment is cyclic or perpetual motion. The cyclic process starts, ends and restarts as follows/42/.

1. 19th century domination by nature
2. Industrial revolution controlling the nature
3. Increased growth
4. Richness
5. More wants
6. Production explosion, consumer civilisation and depletion in resources

It is like Rags to papers, Papers to money, Money to banks, Banks to loans, Loans to poverty and finally Poverty to rags. So perpetual motion brings no happiness to man. It creates only conflict between man and nature. The ideal one is not to control nature or be controlled by nature but only to live in harmony with nature.

6) ENVIRONMENT AND POLLUTION

There are mainly three sets of pollutions.

1. Prosperity
2. Poverty
3. Traditional Habits and Attitudes

Prosperity is that serving only greedy people and not the poor people. An example of poverty is no access to safe drinking water. Eating on the roads, washing in the middle of public places and digging the very nicely laid roads are some of the traditional habits and attitudes towards environmental degradation/43/.

7. ENVIRONMENT AND HUMAN BEINGS

As per Chief Seattle, Devamish Tribe,
"The Earth does not belong to Man
Man Belongs to the Earth
Man did not weave the web of life,
He is merely a strand in it
Whatever he does to the web
He does to Himself"/43/.

Human Beings should realise the above aspects of Chief Seattle and cultivate the good parts of life and build a good environment. The solid wastages in the house are also a threat to Environment. The percentage of solid wastes in average house-hold are as follows.

Papers	:	34%
Plastics	:	20%
Yard Waste	:	10%
Rubber & Leather	:	6%
Food and Garbage	:	3%
Glass	:	2%
Wood	:	4%
Miscellaneous	:	4%
Clothings (Tex)	:	5%
Metals	:	12%

Among the above wastages, paper seems to be at the top. So proper utilisation of the above wastes may improve our environment and economy of life. There are many methods to utilise the waste materials such as recycling processes, reusing the items, and burning to produce energy etc.

1.6 WATER CONSERVATION AND MANAGEMENT

BRIEF DESCRIPTIONS

1. INTRODUCTION

World population is expected to reach 6 billion by 2000. The Question is whether there will be enough fresh water? The earth holds an estimated 7.5 million cubic miles (or 31.33 million Cu.Km) of fresh water. But only about one percent of the above quantity is easily accessible from Lakes, Rivers, Swamps or Underground reservoirs. Yet this tiny portion is more than enough to meet all our present needs. If the total supply and availability of water is not a concern, then its distribution, conservation and management are to be cared by us/40/.

2. CONSERVATION OF WATER

The Conservation is concerned with the utilisation of resources, water being one of them. The factors of Concern are the rate, purpose and efficiency. As it is a well known fact, the water is one of the universal resources available naturally. The major methods of conservation of water are the protection, development and efficient management of water resources for beneficial purposes. Hence our criteria is on Distribution, Conservation and Management. But when water demands are expected to exceed the supply, conservation comes to play its role.

3. WATER MEANS DIFFERENT TO DIFFERENT SECTIONS OF PEOPLE

For scientist, it is the compound of H_2O . But for a sanitary engineer, it is in liquid transparent form from its source to homes, offices, factories and other places. It is kept free from harmful bacteria, be a colourless, tasteless and odourless soft drinks free from minerals. The public need water as an absolutely essential commodity because 70% of total weight of our body constitute water.

4. CENTRAL IDEA OF WATER CONSERVATION PROJECTS

The central idea is to regulate rates at which freshwater flows away. About 10% of World's fresh water are restored in Dams and Reservoirs. Water spreading system is used by constructing a series of dikes to capture spring of fall run off. Water is used to irrigate land for crops. Excess water is directed into a natural waterway.

5. STRINGENT CONSERVATION MEASURES

1. Sewage treatment and recycling
2. Desalination plants
3. Combatting evaporation
4. Save water campaigns
5. Rain water-catch and save

6. SAVING RAIN WATER

About 110 cms of rain occurs in Madras city annually. Plenty of water can be saved if it is prevented from its run off into sea. The main methods are as follows/41/.

1. Recharge our wells and improve their levels
2. Enhance water quality in wells
3. Prevent cracks in buildings

7. PROCEDURE TO SAVE RAIN-WATER

The methods are as follows.

1. Land rain water from terrace into your well through drain pipe.
2. Dig number of percolation pits of diametre of 30 cms at one internal metre.
3. Erect wells at entrance and exit gates to return the water into the compound.

8. WATER MANAGEMENT PROBLEMS

They are

1. Economics
2. Social
3. Intangible values

The above problems can be solved by water management technology. This technology has two methods to attain the desired goals. They are biological methods and mechanical methods. Growing upland vegetation having low moisture is one biological method to manage to water resources. The mechanical or Engineering methods are water spreading and percolation pits for ground water recharge.

9. DESALINATION PLANTS

Easy solution to acquire more water is to convert to fresh water. But the process involves more capital amount. But in South-East Arab countries where an acute water scarcity exists, people have established a big Desalination plant for converting sea water to fesh water. Sea water conversion seems to be the best alternative.

2.0 EVALUATION AND ASSESSMENT OF THE REACTION OF VISITORS

Introduction

The objective of this independent study is to evaluate and assess the reaction of the visitors towards the Science Centres which were the informal backbones for the upliftment of the societies. In this venture, Questionnaires of different kinds have been planned and evaluated the feedback received from visitors to our Centre who are from different sections of the society. The students of schools, colleges, polytechnics and the general public are the visitors to our Centre. Conducting this exercise is to make this system fullproof. The developments of questionnaire of different kinds will be dealt in this analysis. A questionnaire of general type regarding the infrastructure facilities of a Science Centre has been prepared. The other types of Questionnaire were on the Exhibits, Learning styles of visitors and Psychological behaviour of children inside a Science Museum. The sequential steps involved for evaluation are designing and preparing Questionnaires, circulating to various groups of visitors and compiling the reports, finally, evaluating the statistical data received from different visitors. Among all these steps, the last step is crucial in deciding on the analysis and follow up of results.**ENDFIELD**

Analysis

The questionnaire of the first type consists of 22 questions pertaining to the details of the visitor; his likings towards the Centre; timings and locations; facilities like parking of vehicles, canteen and civil amenities; regarding Planetarium; regarding Science Centre; new idea or methodology; and their criticisms and suggestions. The data has been collected from the visitors of all ages and they have been analysed with respect to the above groups. A copy of the questionnaire is enclosed for ready reference in Appendix-I.

The other Questionnaires

The second questionnaire will be dealing with the exhibits. Some Interactive exhibits will be chosen and they will be presented to different visitors for remarks and we evaluate their reactions.

The third type of questionnaire will be on learning styles in Development of Exhibits. Hence the questionnaire tries to bring out different meanings and issues related to learning style and trace its history with its roots in physiology. This will thoroughly examine the implications and applications of the learning style in Science Museum's Education. In fact, we can say that, learning styles are the useful tools through which one can make the learning in Museum atmosphere more effective and efficient. By analysing different learning styles of the visitors, one can evaluate the type of Science Centres needed for the future.

2.1 ON "SCIENCE CENTRES"

The questionnaire or type - I of about 200 numbers have been circulated to the various visitors of this Tamilnadu Science and Technology centres, Madras - 25 and received data on 22 questions about the activities of Science Centre.

The datas thus collected have been studied and fed to the computer for plotting histograms for questions. The 8 histograms are enclosed for your kind perusal in Appendix I with different Tables and explanations of results.

QUESTIONNAIRE - I

From the datas and histograms, the inferences derived are explained below :

THE TITLES OF THE EIGHT HISTOGRAMS ARE AS FOLLOWS :

1. Influence to Visit Science Centre
2. Seeking for
3. Visiting Months
4. Reasons for visiting months
5. Facilities
6. Planetarium programme
7. Science Exhibition
8. Halls of Science

1. INFLUENCE TO VISIT Science Centres :

From the histogram No.04, it is clearly known that only friends have motivated the people to visit the Science Centre. Datas have been collected from 200 visitors. Out of which 66 have come to know about this Science Centre through friends (33%) : 54 through News itsm (27%); 42 through other categories (21%) ; 38 through children (19%). This indicates that the information about the Science Centre is communicated maximum through friends. As per the proverb 'A Friend in need is A Friend indeed', these friends are helping for the reformal of society towards the achievement of knowledge advocating through Science Centres. The next rank comes the news items, Via Newspaper, Radio, TV and other media.

2. SEEKING FOR :

From the histogram No.05, most of the people visit the Science Centre for seeking knowledge of Science and Technology principles and their applications. Out of 200 visitors the knowledge seekers are 158 (79%); the entertainment seekers are 34 (17%) and the others are 8 (4%). This proves that Science Centres are of the informal education centres which imparts knowledge in Science & Technology to the students and the public.

3. VISITING METHODS :

From the histogram No. 06 (a), the visitors who have opted maximum liking month of the year to visit this Science Centre namely May, are numbering to 60 out of 200 (i.e. 30%). Secondly, 46 visitors (i.e. 23%) have opted from November, thirdly 38 visitors (i.e. 19%) for October.

In a year, two peaks of high density of visitors are observed. One is during summer holidays from April, May and June and another peak observed from October, November and December. The second peak is due to the pleasant Winter season of Madras.

4. REASON FOR VISITING MONTHS

From the histogram No. 06(b), it is inferred that main factor for the reason of the visiting months of the visitors is due to the holidays only. The second aiding factor is that of the pleasant weather. The number of visitors who have opted for Holidays as reason are 54 of 200 (27%) and that for weather as reason are 34 of 200 (17%).

5. FACILITIES (07 TO 12)

The visiting timings for this Science Centre have been preferred favourably by 172 visitors out of 200 (i.e 82%). Most of the visitors preferred day time planetarium shows and science exhibition

Regarding the parking vehicle rates, 142 visitors out of 200 (71%) favoured positively. Canteen facilities have ben liked by 118 visitors out of 200 (i.e. 59%).

50% of the visitors have liked the souvenir shop and others have commented to introduce science and technology related toys andkits for learning hands - on experience of science.

11% of the visitors have observed our advertisement boards which were of size 3' x 2' and installed in 5 locations nearer to our centre in Madras. Lack of advertisement is due to the increase in cost of making proper size boards. Another bottleneck is that the Corporation and Traffic Department do not allow us to put up larger size boards due to the hindrance to pedestrians.

General amenities like toilet, washing and drinking water were liked by 138 visitors out of 200 (i.e 69%).

6. PLANETARIUM PROGRAMME

The awareness of the change in the planetarium programme were noticed by 122 visitors of 200 (i.e. 61%). Among the visitors who have noted the change - overs in the planetarium programme, 68 (i.e. out of 122) were visiting the planetarium (i.e. 55%).

158 visitors out of 200 (i.e. 79%) have accepted the entry fees for planetarium programmes during 1995-96.

150 visitors out of 200 (75%) were satisfied with the planetarium programme during 1995-96.

From the above it is inferred that the percentage of visitors to planetarium is more and they like also the planetarium programmes.

7. SCIENCE EXHIBITION AND PARKS

142 visitors out of 200 (71%) have liked the exposure of exhibits in the Science Centre. Only 19% have given their criticism against the exposure of exhibits which are reasonable. The remaining 10% have offered no remarks. Probably they are not able to give their comments due to their less literacy of knowledge.

160 visitors out of 200 (80%) have accepted the comment that science exhibits arouse curiosity among the children for learning science.

142 visitors out of 200 (71%) have agreed to the new concept of displaying the Science Exhibits an open area namely Science Parks. The remaining 29% have neglected due to their unawareness of this concept.

8. HALLS OF SCIENCE

Among the 200 visitors, 122 (i.e 61%) have visited all the five galleries such as Periyar, Energy, Transport, Electronic & Communication and Physical Science.

Regarding the best gallery liked by the visitors, Electronics & Communication stood first attaining 46% of the visitors. The next came Transport gallery with 35% and 26% for Physical Science; and 21% for Energy; and 24% for Periyar (Dolls Exhibition). The percentage figure include the visitors who have opted their best for more than one gallery.

QUESTIONNAIRE - II (ON EXHIBITS)

In additon to the above works and results of the Questionnaire I, the next questionnaire - II on exhibits has been developed with the aim of getting feedback from visitors on the aspects of the selected science exhibits of different galleries such as Electronics & Communication, Transport, Energy and Physical Science. The finalised questionnaire- II is enclosed in the Appendix No. 2. The circulation, collection & anlaysis of data have been carried out under this study.

QUESTIONNAIRE - III (ON LEARNING STYLES)

This questionnaire on Learning styles has given the feedback on behavioural aspects of the visitors of the Science Centre. Some of the aspects such as reading habits, concentrations, their motivation, physical behaviours, structural, operational tastes and visionary likings were dealt in this analysis. The necessary works on this questionnaire have been executed under this study.

CONCLUSION :

The histogram charts of all the above eight items along with a questionnaire are enclosed with this report in Appendix - 1 for reference. The major comment from the observations of the visitors is that they definitely liked the concept of Science Centres, Interactive exhibits, Science park and they want this Science Centre to be another form of Informal Educational Centres.

2.2 EVALUATION OF VISITOR'S REACTION ON SCIENCE EXHIBITS

Introduction

The work on evaluation of visitor's reaction on "Science Exhibits" has been started in Tamilnadu Science and Technology centres. The galleries taken for this evaluation are as follows.

1. Transport
2. Electronics and Communication
3. Physical Science and
4. Energy

In this connection, the following works were under taken.

1. The questionnaire has been prepared on exhibits and circulated to the visitors from 28-03-96. The questionnaire on exhibits is enclosed in Appendix - 2.
2. So far feedback from 200 visitors have been studied and data collected.
3. The quantum of total visitors to be surveyed will be 200 maximum.

Result

The data has been analysed by taking statistics of the data through different methods.

The following analysis had been carried out.

1. Visitor's attitude toward the exhibits in different perspectives such as science background, aesthetic background or general background.
2. Effect on non-scientific background persons towards the science exhibits.
3. Field of interest
4. Psycho feeling of visitors
5. Expectation of different types of visitors on exhibits.

QUESTIONNAIRE ON "SCIENCE EXHIBITS"

In continuation with my study, the questionnaire of type - II of about 200 numbers have been circulated to the various visitors of this Tamilnadu Science and Technology Centres, Madras - 600 025 and received data on 20 questions about the evaluation of visitor's reaction on Science Exhibits.

The data thus collected have been studied and fed to the computer for plotting histograms for questions. The 14 histograms are enclosed for your kind perusal in Appendix - 2.

QUESTIONNAIRE - II

From the data and histograms, the inferences derived are explained below.

The titles of the 14 histograms, the inferences derived are explained below :

The titles of the 14 histograms are as follows :

1. Influence to "Bus - Chassis"
2. Inducement to "Model Broadcasting studio"
3. Impressed aspect to "Weights and Different planets"
4. Impressed most to "Nuclear Fissions"
5. Liked most in Engine section
6. Which group of transport system . Impressed ?
7. Liking satellite communication
8. Attempts to find your age
9. Liked and laughed mirror
10. Attraction in the "World Clock"
11. Forces on Energy Ball
12. What is the green colour?
13. How shadow caught on screen ?
14. Number of elements in periodic Table

Most of the exhibits selected, belong to Physical Science, Transport, Electronics & Communication and Energy subjects. The children (between 12 years to 18), your students (from 18 to 25), adult (from 25 to 35) and middle aged and old aged upto 65 years for both sexes have applied their mind and exercised their body to solve these questions on their own accord. Among these groups of people, there are many non-scientific people who approached these problems.

The data on all 20 questions have been collected from 200 visitors from 15th March 1996 to 25th May 1996 in Tamilnadu Science and Technology Centre, Madras. The percentage of number of visitors for each category of each question is taken as a coordinate on the Y-axis while the categories have been allotted on the X-axis. Totally there are 14 histograms, shown in Appendix No. 2.

1. Influence of the Exhibit "Bus - Chassis"

From the histogram No. 05, 48% of the visitors have preferred towards the exhibit "Bus Chassis" on the "GEAR SYSTEM". This shows that the visitors are keen on watching on the motion and selection of gears in automobile (Refer Q.05). The second, third and fourth order of ranking are for cutsection, working in motion and aesthetic look. The visitors prefer the working than the aesthetic look or appearance.

2. Inducement towards "Model Broadcasting Studio"

Form the histogram No. 06, 28.5% of visitors have opined this model broadcasting studio as a replica of AIR Studio. The lowest percentage of visitors is for the understanding the principle of broadcasting. This shows that people are visiting the Science Centres for entertainment and also become opportunist in utilising the big models like Model Broadcasting Studio which they would find difficult in visiting the real studios (Refer Q.06).

3. Impression of "Weights on Different Planets"

Display of this exhibit is liked by 21% of visitors. Also people (20.5%) preferred equally the answer Jupiter planet which was in the news recently. Many visitors of 12% could not answer this exhibit. The reason may be that they have not understood the concept on acceleration due to gravitation (Refer Q. 07).

4. Nuclear Fission

Effect of splitting of heavier elements has been attracted by 38% of the visitors. The next is the lighting sequence by 34% which is very much equal to the above one. The visitors are attracted by the lighted and animated portion of exhibit (Refer Q.08).

5. Engine Section

About 35% of visitors have liked the Ambassador car engine which is the most prevailing vehicle in Madras. The next comes the Multi cylinder engine. Here the visitors are attracted towards the motion of piston cylinders in and out in the engine (Q. 09).

6. Transport Systems

39.5% of visitors have liked the road Transport systems very much. The Rail and Sea Transport Systems come equally as second rank and the third is Air Transport. The difference between the Air Transport and Rail and sea is only 0.5%. This shows that the visitors are equating and giving equal importance to Air, Sea and Rail Transport systems. But Road Transport, the common man's Transport system is liked by maximum visitors. (Refer Q-10).

7. Satellite Communiation

The globe rotation has attracted by 35.5% of visitors. Running LED movements depicting the path of communication from the Satellite to Earth Station and vice versa has stood second in rank. This shows that movement and communication aspects have been liked by the general visitors than the static exposures (Refer Q-11).

8. Find Your Age

From the results, it is clear that more adults have tried this exhibit. The visitors whose age more than 27 tried maximum attaining 47.5% in the their strength. Many visitors of 15.5% have not tried this exhibit due to their inability to understand (Refer Q-12).

9. Fantastic Mirror

39% of visitors have liked the shape convex-concave due to its funny images. This shows that people are interested in a lot of changes in exhibit than keeping the plain structures (Refer Q-13).

10. World Clock

46% of Visitors have likened the time selection method in getting times of different places in the world (Refer Q-16).

11. Circus of Force

28% of Visitors have supported for all the forces acting on Energy ball. They felt exhaustive of exhibit thinking that all the forces are invoved in this circus (Refer Q-17).

12. Colors from Gas

50% of visitors have answered correctly about the coating materials applied at the inner surface of the tube to produce green colours. There was a write-up or label indicating the colours for different materials. Those who read the label, were able to give correct answers. This shows that about 50% of visitors have no patience to look for the labels in the exhibit. So Attractive labels play a major role in the exhibit display (Refer Q-18).

13. Catch your shadow

In this exhibit the reason for the shadow on the phosphorescent screen is due to chemical coating. The 35% of visitors have answered the same. But more visitors (18.5) have left this question due to their lack of knowledge (Refer Q-19).

14. Periodic Table

Here, the total number of elements in this exhibit is printed in the exhibit itself. Visitors, who can watch the exhibits with efforts, were able to answer correctly as 103 elements. 70.5% of them have answered correctly (Refer Q-20).

2.3. EVALUATION BY VISITOR'S REACTION ON "LEARNING STYLES"

Brief Description

The questionnaire - III on the "Learning Styles" has given the feedback on learning styles of the visitors to the science centre. Some of the aspects such as reading habits, concentration, motivation, nature, strength, structure and operational tastes and visionary likings have been dealt in this analysis.

The above work has been carried out in this study. The design of the questionnaire contains 17 questions. The first three questions convey the demographic details of the visitor.

Professional level, learning strength and concentration levels are studied in the questions 4,5 and 6.

Methodology of learning, Environment attachment and companion liking are to be gathered from the questions 7,8 and 9.

Liking of visitors towards their atmosphere of learning in terms of background scenario, sound level and preference in their behavioural taste to visit such learning monuments are being studied in the questions 10, 11 and 12.

Motivation of visitors towards learning and understanding the science, structure and methodology of exhibits are measured in the questions 13, 14 and 15.

The operation and assessment of this Science Centre towards the objective of disseminating the knowledge of science and technology are studied in the last two questions.

Broadly speaking, the following psychological behavioural learning aspects of the visitors are being studied from this questionnaire.

1. Expected measure of professionalism
2. Type of Environment and its companion
3. Likelihood physical background
4. Motivational expectations
5. Physical structure, operations and assessments.

Most of the visitors who visit the science centres react in a normal manner. But sometimes, they are disappointed due to its staff behaviour.

This has been studied from these data using the questionnaire III.

Data Type : The type of data to be collected are primary data which constitute the core of this research. Some secondary data from the other Science Centres have also been collected and referred with our data.

Analysis : After the survey analysis of the data, the numerical data has been tabulated and respective histograms have been plotted through computer and the graphical description of data depicting the information has also been described.

The questionnaire has been described and prepared for the collection of data from about 300 visitors, who visit Tamilnadu science and Technology Centres, Madras.

The work on evaluation of visitor's reaction on "Learning Styles" has been started in Tamilnadu Science and Technology Centres. In this connection, the following works had been carried out.

1. The Questionnaire has been prepared on "Learning Styles" and circulated to the visitors from 26.06.96. The questionnaire on "Learning Styles" is enclosed in Appendix - 3.
2. So far feedback from 200 visitors have been studied and data collected.
3. The quantum of total visitors to be surveyed will be only 200 maximum.

Result :

The collected data from 200 visitors from 26.06.96 to 06.08.96 had been processed for statistical analysis. There were totally 17 questions.

Among these, the first three questions deal with the demographical data of visitors.

The percentage value for the remaining questions from 04 to 17 have been counted and tabulated in Table - 1.

The following analysis has been carried out.

1. Visitor's attitude towards learning of exhibits.
2. The focus of the questionnaire will be on the indicated subjects referred in Table - 1 in Appendix - 3.
3. Also the following psychological behavioural learning aspects of the visitors will be studied.
 - a. Professionality
 - b. Environment and companionship
 - c. Background
 - d. Motivation
 - e. Physical structure, operations and assessments.

4. The computer histograms will be drawn for each subject for visual understanding.
5. The analysis will furnish the concluding assessment of visitors towards their learning styles preferred by them.

In continuation with my study the questionnaire of type - III has been circulated to 200 numbers of various visitors of this Tamilnadu Science and Technology Centres. Madras - 600 025 and received data on 17 questions about the Evaluation of Visitor's Reaction of "Learning Styles".

The data thus collected have been studied and fed to the computer for plotting Pie-charts for the questions. The 14 Pie-charts, Table - I and II are in Appendix - 3.

I. QUESTIONNAIRE - III ON LEARNING STYLES"

From the data and pie-charts, the inferences derived and explained below :

The titles of the 14 pie-charts are as follows :-

- | | | |
|-----------------------------------|-----------------------------------|------------------|
| 1. Professional level | 2. Learning Strength | 3. Concentration |
| 4. Understanding | 5. Environment | 6. Companion |
| 7. Background | 8. Sound level | 9. Visiting time |
| 10. Motivation | 11. Methodology | 12. Structure |
| 13. Operation of Science Exhibits | 14. Assessment of Science Centres | |

The children (between 12 years and 18), young students (from 18 to 25), adult (from 25 to 35) and middle aged and old aged upto 65 years of both sexes have applied their mind and exercised to solve these questions on their own accord. Among these groups of people, there are many non-scientific people who approached these problems.

The data on all 17 questions have been collected from 200 visitors from 25.06.96 to 06.08.96 in Tamilnadu Science and Technology Centre, Madras. The data thus collected are tabulated in Table I. The pie-charts indicate the percentage and the categories. Totally there are 14 pie-charts.

II. THE FOLLOWING ANALYSIS HAS BEEN CARRIED OUT

1. The visitor's attitude towards learning of exhibits - selecting an Ideal Learner.
2. The focus of the Questionnaire - on Learning Styles.
3. Psychological behavioural learning aspects.
4. The computer pie-charts
5. Concluding assessment of visitors towards their learning styles.

III. CONCLUSION FROM DATA ANALYSIS

1. Selection of an Ideal Learner (Please refer Table II)

2. Focus to the questionnaire

The ranks indicating the levels of the visitor's perceptions on learning styles in the Science Centre are shown in Diagram No. 1 of Appendix No. 3. The valuable points derived from this diagram are explained below.

From the first 5 ranks, it is inferred that the modular structure (to be seen as eye-perception), self - operation (to themselves), do and understand and understanding oneself stand most important. This implies that people generally see, do and understand. So our exhibits are to be made with respect to the above phenomena.

The ten ranks from I or X are above 50% while the ranking for regular concentration, friends companion, working sound background and do-it yourself are below

50%. This shows that a Science Centre has to keep up its exhibits at least as per the above 50% level mark.

A relaxed quiet environment of morning time with line structure of exhibits is the learning set-up requirement by the visitors. In that above atmosphere, they want to learn by doing themselves. Modern Science Centres have to create the above atmosphere. Tamilnadu Science & Technology Centre has achieved this set up.

3. Psychological behavioural learning aspects

Behavioural aspects for learning in a Science Centre are influenced by Concentration, Understanding, Environment, Normal Companionship, Self-realisation. Regular Concentration, Understanding by doing, Relaxed environment, Friendly Companion and Motivation by Self-realisation were the required attributes from the data collected among the 200 visitors.

4. Computer Results (Pie Charts)

The pie-charts for the 14 information collected from the questionnaire are enclosed for reference. They depict clearly the percentage variations of different parameters of the different elements of the questionnaire.

5. Concluding Assessment

The concluding part of this analysis will be that the exhibition and the exhibits of Modern Science Centre should be learning centres in a non-formal way having a clean quiet healthy environment, having the above attributes expected by the visitors. Visitors to Science Centre are the prestigious customers for the Science Centres. The customer's satisfaction is the sole requirement to be achieved by the authorities of Science Centre. Hence this study on Learning Style has opened our eyes to look into the above attributes for the future Science Centres.

CHAPTER - III

III PART - II

STATUS OF SCIENCE CENTRES

Brief Description :

The objective of my thesis is to emphasize the need for the development of Science Centres for the futuristic requirements of the Society. The evolution of new Science Centres depend on many factors mainly on the development of Science and Technology, on an indepth understanding of the science by the people as indicated. This research work has analysed the past and present status of Science Centres in India and Abroad.

A correlation has been worked out between the existing models of Science Centres and the future trends of Science Centres.

For the above analysis work, the study works on different Science Museums in Germany has been carried out by me from January 8, 1996 to March 6, 1996.

The structure of the study tour is as follows.

1. Visit to Deutsche Science Museum, Munich, Germany.
2. Visit to Science Museums in Southern Germany.
 - a. Siemens museum
 - b. BMW Museum
 - c. Stadtmuseum Munich
 - d. Mercedes Museum
 - e. Museum of Technology and Labour Mannheim
 - f. Postmuseum Frankfurt
 - g. Museum of Natural History in Munich and salzburg.
3. Visit of Museums in Northern Germany
 - a. Industrial Museums in Rheinland
 - b. Museum Hagen
 - c. Museum of Transport and Technology.

1.0 Past and Present status of Science Centres in India and Abroad.

Introduction

India, being the most important democratic developing country in South East Asia, plays a key role in promotion of Science and Technology for the masses in the forthcoming 21st century. Like other developing and developed countries, India has already entered into this field of science museum from the 19th century for the past 30 years. In this context, the birth of a Science museum namely Birla Industrial Technology Museum (BITM) and Birla Planetarium, Calcutta established by Birla group in collaboration with National Council of Science Museum, NCSM, Government of India, whose chairman is Dr. Saroj Ghosh, is a pivotal starting milestone for the other developments.

Pandit Jawaharlal Nehru had keen interest in the development of science and technology for the people of India. He took efforts to develop the NCSM, Calcutta and enunciated many schemes for establishing many more Science Centres in India. Next in Bangalore, Viswasvareya Industrial Technology Museum (VITM) had been opened to the public by Dr. Viswasvareya, Industrialist of Mysore. NCSM since then developed many Science centres such as in Bombay and Delhi. Many District Science Centres have also been sprung up from different states of India. As the knowledge of science has to be extended to the every distant public of villages, Rural Science Centres have also been developed.

In addition to the efforts taken by Government of India, many states individually has taken initiative and interest in establishing numerous Science Centres and Planetaria in different parts of the country. For example, in Tamilnadu, the State Government has established the Tamil Nadu Science and Technology Centres in 1983. The TNSTC, to begin with has set up a Science and Technology Centre in Madras with 7 galleries on science and technology themes such as Transport, Electronics and Communication, Physical Science, Energy, Materials Science, Life Science and

Innovative Gallery. In addition, Birla Planetarium has also been established with a seating capacity of 235 seats with a modern computer controlled projector imported from Japan. In addition a Science Park, a Traffic Park, an ECO Park, an Energy Park and a Model Meteorological Observatory have also been developed. Presently, Tamilnadu Government has proposals to establish Science Centres and Planetaria in other districts of Tamilnadu such as Trichy, Coimbatore etc.

On a similar effort, Kerala Government has also established Planetaria in Thiruvananthapuram and Cochin. In several parts of India Science Centres have been established.

Science Centres In Developed Countries :

Major developed countries are United States of America (USA), Europe, Asia and Eastern countries like Japan, Singapore etc. There are many Science centres in USA, Europe and Asia. The developed countries for the past one century have introduced the concept of Informal Exposure of Science awareness programmes to the public. Presently Internet Network Communication for the Science Centres are being introduced. One can now construct a Science Centre with out any boundaries or walls. Computer Network Communication will be having all attributes of a Science Centre except the building and real exhibits.

The Multimedia System concept is currently revolutionalised the Science Centres with all the details stored in layers on a Multimedia Station so that the visitors have to play with the touch screen only. Also different Science Centres can exchange the data on various fields for constructing a Multimedia System in a particular subject. The coordination among the Science Centres of the whole World may be improved and utilised for the best possible data given to the visitors.

Science Centres in Developing Countries :

The achievements in science and technology attained by the developed countries must be disseminated in developing countries. The awareness leads to acquisition of modern products due to the advances made in science and technology. Awareness, Acquisition and Usage lead to the understanding and learning of Science and technology amongst the people of developing country. Governments of developing countries are contemplating to introduce the concept of Science Centres for the propagation of science among the people. Science Centres are different from Science Museums. Science Museum is a collection of artifacts and other real models made by the inventors of scientific achievements. While Science Centre is a collection of interactive type of exhibits which can be handled by the public eventhough they don't have the knowledge of science. Science Centre is not a school, college or infact any educational institution. It is an informal institution where the visitors (public) will be exposed to the 3 dimensional working models on science and technology. They are not directly taught as in other educational institutions. It is an intuition given to the general visitors to rekindle their mind.

Conclusion :

With the above aim, in my research work for this study I have collected the following data towards achieving the purpose of study on Science Centres.

1. Statistical collection of various Science Centres in India and Abroad.
2. Data on the galleries of various centres.
3. Data on the exhibits of the galleries.
4. Various turnout in some of the Science Centres.
5. Data on recent Multimedia System of different Science Centres.
6. Attitude of Science museums or other museums towards Science Centres.

The details of data collected have been presented in this review.

1.1 Statistical collection of various Science Centres in India and Abroad :

In India, there are six major Science Centres occupying all directions as the nodal centres. The main crust of the formation of the Science Centres is to inculcate the basic knowledge of science to the common man and also to disseminate the essence of science to the downtrodden people of India.

There are nine Regional Science Centres coming under the control of various main Science Centres as above. Similarly, There are District Science Centres coming under the control of Regional Science Centres.

In addition to the above, School Science Centres, Rural Science Centres, Mobile science exhibition (by Museo bus i.e. Science on wheels), Central Research and Training Laboratory, Hall of Science and Technology and Energy, Science parks, have also been established in India. They add on the shelves for the popularisation activities on S&T among the common man.

Science awareness programme such as Science Education, Training, Creativity, Community programme have also been conducted along with these main programmes.

From the data (See Appendix No. 4), it is inferred that BITM, Calcutta ranks the best and oldest Science Centre in India having infrastructure and facilities needed for the Indian programmes. Major Science Centres in Bombay, Delhi, Bangalore and Madras created on the basis of BITM, Calcutta to diversify their activities in these regions.

1.2 Data on the Galleries of Various Centres

Overall, the galleries on Transport, Energy, Materials Science, Life Science, Innovative, Electronics & Communication, Physical Science, Atom, Motive Power, Popular science, Electricity, How things work, Underground coal mine, Children's

Science Discovery corner and Computer corner have been included in the various major, regional and district Science Centres.

In Deutsches Museum, Germany they have Environment, Metals, Coal mines, Materials Testing, Computer Science, Tele-communications, Printing, Astronomy, Amateur Astronomy, Astronautics, Physical science, Chemistry, Industrial Chemistry, Aeronautics, Geodesy, Ship and Textile Technology.

From the given data (See Appendix No. 4) it is found that most of the themes generated in Indian Science Centres look alike with the Science centres of Abroad. Also the nature of the exhibits such as interactive, reactive and active models resembles same. The type of visitors and their behaviour with the Science Centre differ in India and foreign Museums due to their culture, strength of population and economy.

1.3 Data on the exhibits of the galleries

Most of the exhibits used by the different Science Centres are of participatory in nature. Visitors directly handle the exhibits and infer the knowledge of the exhibits depending on their ability. So the exhibits and the visitors are two independent categories and their interdependence is found to be linked with visitor's knowledge, ability, interest and attitude.

Taking into above behavioural aspect of the visitors, the exhibits in the galleries of India have been designed and displayed. Some of the exhibits such as Animated Dinosaur model, Aquamobile, Giant - Energy Ball, Engine - Hall, Fun Science exhibits such as Fluidics, Perpetual motion, Vibration attract people of all categories.

The present concept of Science Centre, exhibits without boundary walls, namely Science Park exhibits play a vital role to enact with the exhibits in open environment. The data on the exhibits on the galleries are enclosed in Appendix No. 4.

1.4. Various turn-out in some of the Science Centres for the Past Five Years Period

Table - I

Year	BITM Calcutta	NSC Bombay	National Science Centre Delhi	VITM Bangalore	TNSTC Madras	Annual Total
90 - 91	2,09,177	2,25,243	39,989	2,43,979	96,024*	8,14,412
91 - 92	2,37,741	2,91,387	29,380	7,98,237	1,76,398	15,33,143
92 - 93	2,57,645	2,66,347	1,77,112	8,94,839	1,37,944	17,33,887
93 - 94	2,36,757	2,93,591	2,00,195	9,75,687	1,35,059	18,41,289
94 - 95	2,48,639	2,96,327	2,02,116	8,42,480	1,38,821	17,28,383
Total for 5 Years	11,89,959	13,72,895	6,48,792	37,55,222	6,84,246	76,51,114
Average per Year	2,37,992	2,74,579	1,29,758	7,51,044	1,36,849	15,30,223

* Started from September 1990.

1.5 Data on recent Multimedia system on Different Science Centres in India

- 1 **Name of the Science Centre:** Birla Industrial and Technological Museum, Calcutta
Year : 1990 - 91
Name of Presentation : A multi-media presentation on the **History of Electronics** depicts the chronological development of Electronics right from the discovery of electron.
- 2 **Name of the Science Centre:** National Science Centre, Delhi.
Year : 1990 - 91
Name of the presentation : In the gallery on **Information Revolution**, A multimedia presentation on the state of information and communication five decades ago. The scene is laid in the Red fort during the morning in the Independence Day.
- 3 **Name of the Science Centre:** Regional Science Centres, Bhubaneswar and Guwahati.
Year : 1993 - 94
Name of the Presentation : A multimedia presentation based on **Are we alone in this Universe?** This exhibit tells us the story of the uniqueness of our planet. It gives us information about why it is so difficult to trace life in any other extra terrestrial body. The mind boggling phenomena relating to cosmology are explained through a well scripted narration supplemented by simultaneous projection of interesting visuals. The exhibit has a 24' screen and the projection system uses dissolver units along with micro processor control.

Multimedia System in Abroad :

4	Name of the Science Centre:	Deutsches Museum, Munich, Germany.
	Year	1994 - 95
	Names of the presentation :	Five multimedia stations have been designed using touch screen, TV monitor and IBM PCAT Computer system and Software system. The subject is on History of Printing and Its Technology.

1.6 Attitude of Science Museums or other Museums towards Science Centres :

In India, many general Technological Museums and Science Museums have been performing well in many different topics. The main difference between the general Museums and Science Museums is that the graduates in Arts and History and Conservators and a few chemists will run the general Museums, while the scientists and technocrats run the Science Museums. Here even the budgeting is different for both these types.

The co-operation between the General Museum and Science Museum is not much prevailing, due to many reasons. In India, Most of the Science Museum / Centres are governed by National Council of Science Museums under the Ministry of Culture. While the general Archaeological Museums are having their traditional set-up in cultural department with their ethnocentric aspects.

Recently, it has been observed that the general Archaeological museums also want to establish Children' science corner in their museums. They have established even out - door Science park exhibits in their campus. This shows that slowly there will be a mixture of Science and Archeological Museums and the popularity of Science Centres over the general museum will be enhanced in manifolds.

CHAPTER - IV

IV PART III

THURST AREAS NEEDED IN SCIENCE CENTRES

1.0 INTRODUCTION ON MATERIALS SCIENCE GALLERY

Development of thrust area in Science & Technology - Materials Science Gallery for the Modern Science Centre.

Presently, the Materials Science is one of the thrust areas in Modern Science. Many materials from the same raw materials have been developed and gone into production stage. Materials may range from sand, stone, coal and wood to modern materials like ceramic, procelain, plastics and glass. The wide diversity in the description of materials has invoked the scientists to expose them to the future generation for their use and further expansion.

In this connection, the Materials Science gallery has been designed, developed and opened to the public in Tamilnadu Science and Technology centres, Madras.

The following types have been covered in the Materials Science gallery.

1. Metals (Iron and Steel / Non Ferrous Metals)
2. Modern Materials (Powder Metallurgy / Modern Ceramics)
3. Traditional Ceramics
4. Glass
5. Plastics
6. Composites
7. Wood
8. Stone

The above eight topics are the spatial sections of the new Materials Science gallery. The sections are divided into four groups that repeat themselves in every sections.

General Information (Introduction)

In this group, visitors are informed in a more general way about the historical development, the main use, characteristics and familiar products and the production. An alternative medium such as hands -on-exhibits or diorama should hold the visitor in this part of the exhibition for communicating the essentials of the topic as advance organisers.

Properties and Structures :

This group is the main part of the gallery and includes many opportunities of interaction for the visitors. They can find out what the characteristic properties of a material are; but a lot of surprising properties should arise and intensify visitor's interests and effect a deep involvement with the subject.

Extraction, Preparation, Production, Forming, Polymerisation or Processing

These terms stand for the stages of producing the basic materials. These differ hard from material to material ; therefore several processes are to be taken into account. As medium, a multimedia - system for presenting video parts of the processes has been used.

Shaping, Casting, Plating, Manufacturing, Processing, Sintering or Construction

In this group, visitors are exposed to original products of domestic and industrial uses with models or original diagrams for presenting the processes. Also the multimedia system plays an important role.

In the different sections of the Materials Science gallery, the main emphasis is on the communication of the important message "**Great Variety**". The second and the most relevant aspect is a great competition between the different materials for traditional and new fields of applications. Then they are put to use a lot of fibres of different materials.

As the requirements or demands arise, one material has not the properties needed for designed purpose : therefore, a combination of materials must be applied.

In the Materials Science gallery, it is to react to this state of art by integrating the topic "Composites" as an important section of the gallery and by connecting all sections through a transit element.

Planning a new gallery and developing a script of the gallery takes more than one year. But, by using modern planning methods, the process can be accelerated, but nevertheless it is not possible to produce complete script in short time. Therefore the structure of the gallery has been planned and data-set have been developed so that every spatial unit of the exhibition has been registered and worked out the selected selections.

The sections like Traditional ceramics, glass and plastic were completed for the Materials Science gallery. The script will be including the main messages as well as the description of the objects and media and the spatial units. Additionally ground plans and front views of the spatial units communicate a first impression of the exhibition. Plans of the hands-on-experiments support the design of the further exhibits. For the sections traditional ceramic and glass, a multimedia script has been developed and presented in this study in Chapter IV.

In order to facilitate the planning, a structure for the main messages as well as the objects and media have been prepared.

1.1 CONCEPTUAL DESIGN ON METALS, MODERN MATERIALS, TRADITIONAL CERAMICS & GLASS

The thematic entrance to the Materials Science Gallery starts and ends with Ore/Minerals as shown in the structural block schematic diagram in Appendix-05. The following are the main blocks of the structure of the Materials Science gallery.

Main Blocks of the Materials Science Gallery :

- | | | |
|-----------|---------------------|-------------------------|
| 1) Metals | 2) Modern Materials | 3) Traditional Ceramics |
| 4) Glass | 5) Plastics | 6) Composites |
| 7) Wood | 8) Stone | |

All the above blocks are interconnected by means of transit area blocks which have inner significance of the prior and post departments of the main blocks. The transition from one block to another is realised by means of transit areas. The areas are of vital importance for learning the developments of new components for the modern future world requirements.

The following are the transit blocks in between the main blocks :-

- | | |
|--|---------------------------------------|
| 1) Filaments / cutting tips / pistons /
Drilling bits | 2) Porcelain/Abrasive Materials |
| 3) Enamel / Glass Ceramics | 4) Synthetic / Textile / Glass Fibres |
| 5) Sticking Foils Adhesives | 6) Laminates |
| 7) Carbon | 8) Ores / Minerals |

All the 8 main blocks are interlinked via the 8 transit blocks. This should be the main important concept to be introduced in the future Science Centre for designing new science galleries. The idea behind it is to create the historical connections among the amalgamation of materials developed in all parts of the world.

People who visit this type of designed galleries will have a thorough understanding of the subject of the gallery in detail in an informal way. While they are visiting the gallery, they will be landed in to the respective slots of coherent connection of the subjects.

For each of the blocks, the data files have been created with the following information.

TNSTC 1. Materials Science 1. Introduction

Main Topics :-

--

Object - Media

--

--

Spatial units

--

Remarks

--

Description of the components of Data File :-

Main topics : This section explains the topics of the concerned exhibits and the transit topics.

Objects Media : It contains the explanation of Block schematic, Diorama, Models, Originals, Demonstrations, Hand-on-Experiment, Observation Stations, Photographs, Wall display, Installations etc.,

Spatial units : This contains the drawing code numbers and their brief details of the objects -media. The drawings and other details will be annexed at the end of this report.

Remarks : This contains only special precautionary details about the exhibits, their display techniques etc.,

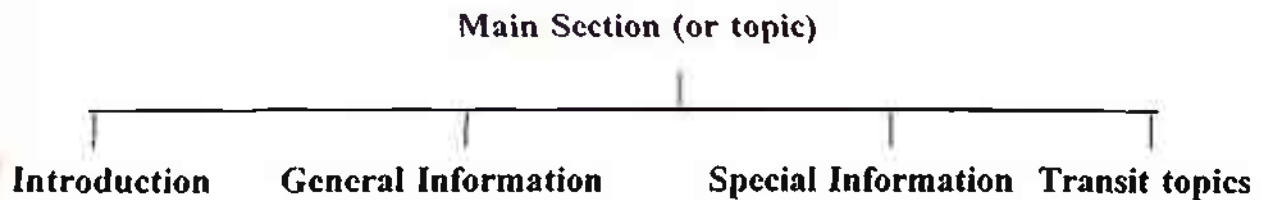
Result : The enclosed data files for the blocks (both main and transitory) have been prepared and a section on plastics is submitted in the Appendix No. 5. Similarly other sections have been designed and prepared.

1.2 CONCEPTUAL DESIGN ON PLASTICS, COMPOSITES, STONE & WOOD

INTRODUCTION

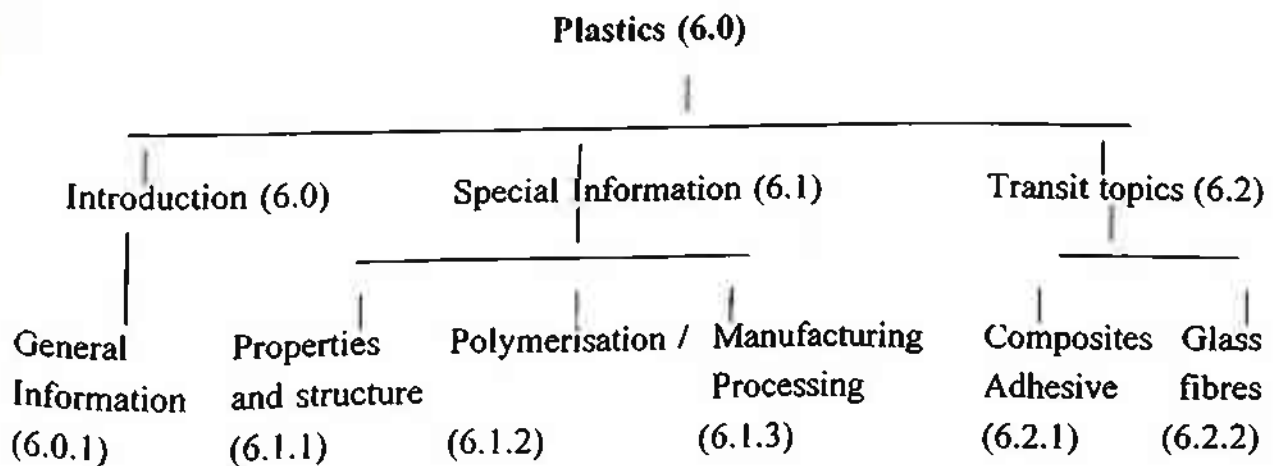
The remaining portions of Materials Science Gallery such as Plastics, Composites, Stone and Wood have been designed and presented in this report of this study. The structural block diagram is enclosed in Appendix No. 5.

Each one of the sections is divided into three or four categories as shown below.



I PLASTICS

The plastic section consists of the following categories.



The above topics have been explained in the section No.6 from 6.0.1 to 6.2.2. Some of the Hands-On -Exhibits to explain the properties of plastics incorporated in the above sections are as follows :

- i. Flexibility of Heat ii. Strength of Plastics
- iii. Chemical Resistance iv. Shortening rubber by heat
- v. Nylon Rope Trick

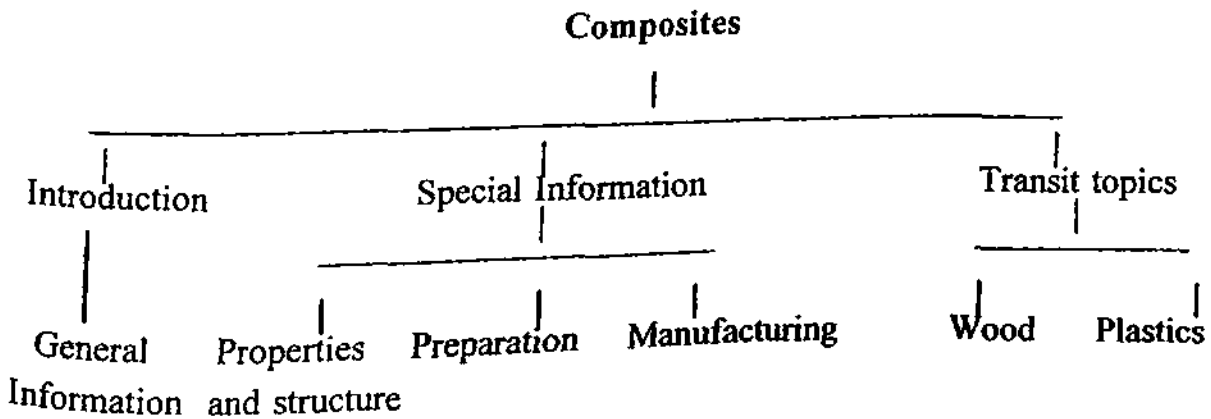
The diagrams for the above experimental exhibits are also shown in the plans at the end of the report.

Also, Plastics section has input transit areas as Glass and output transit area as Composites. In addition to the above hands-on-exhibits, the manufacturing / processing of plastic are shown on an Interactive Wall and the originals like Plastic Injection Moulding machine, Deep Drawing machine are explained. An original bench of laminated glass is also displayed. Here the visitors can see the different layers when sitting on the bench.

The main highlight of this plastic section is the making of 'Nylon Rope' via the exhibit namely **Nylon Rope Trick**. The experimentation process is explained in the section 6.2.2.

II COMPOSITES

This section contains the following items.



The above aspects have been explained in the above section.

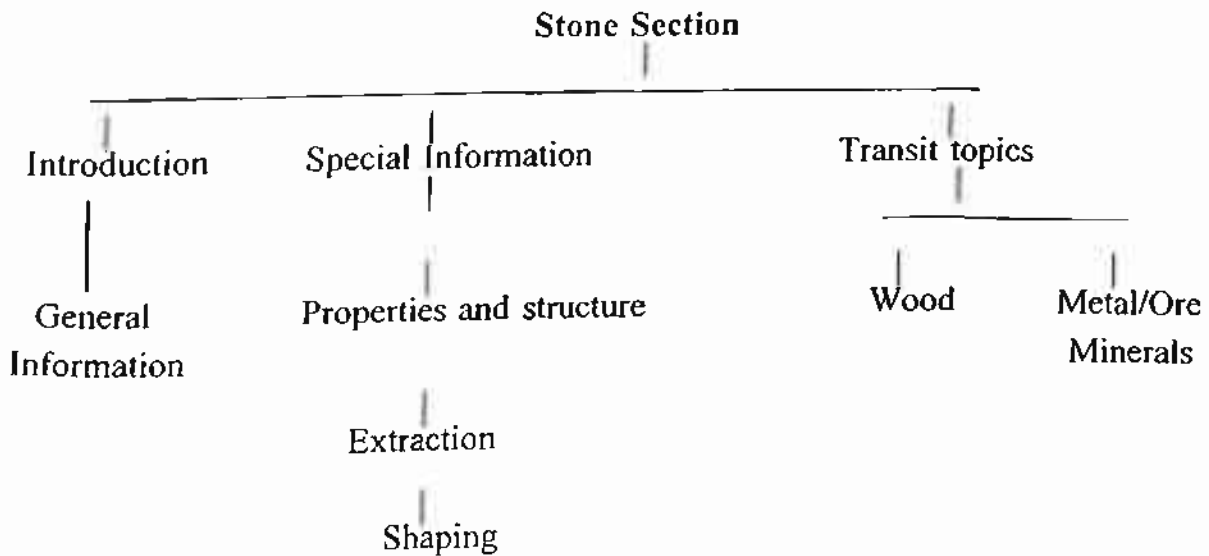
Some of the hands-on-exhibits on composites are as follow.

1. Characteristic aspects of composites
2. Physical Weight Reduction-experiment
3. Strength-experiment
4. Resistance - experiment
5. Interactive wall of composites
6. Typical property of wooden composites

Transit areas for the composites are wood and plastics. The display of various objects made by composites of various materials is also included in this section. Metal Matrix composite for turbine blades, Carbon fibre or Glass Fibre Reinforced Plastics (GFRP) will be displayed. Carbon fibres have been used in the oil platforms because of their reduction in weight and at the same time of strength equal to the steel.

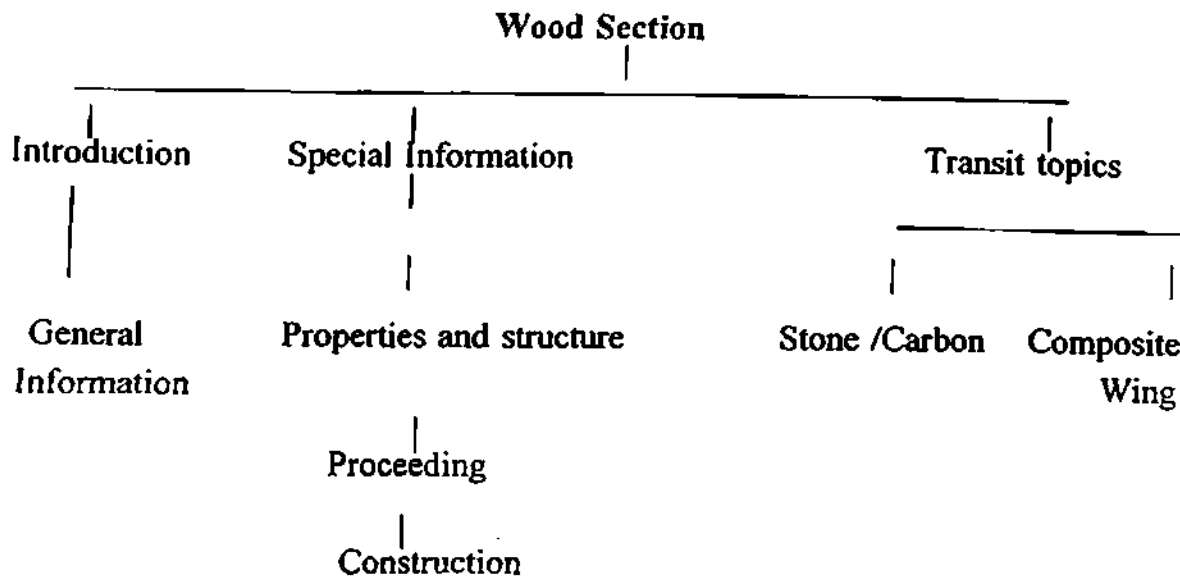
III STONE AND WOOD

Stone section deals with the different types such as General Stones, Flint, Lime and slab stones. Some of the mines of the above stones may be described and displayed.



The above tree diagram explains the design of the stone section. The highlights of this section are the hands-on-exhibits such as Transparency and Opacity of special stones like Quartz or Calcite, Molecular structure of different crystals, two images through calcite stone etc.

Wood section and Minerals become parts of the transit areas of stone. Wood section explains the importance and distribution in general.



The highlights of Wood Section are hands -on-experiments such as strength of glued wood, floatable & non-floatable properties, Age of tree from its grains, Thermal and Electrical insulation.

CONCLUSION

The sections mentioned in the Materials Science Gallery are also depicted in a Matrix Diagram indicating the main topics and their transitory topics. The idea in designing the sections with their transi, tories is exemplified in this structure and it is an innovation for the Modern Science Centres. The transitions from one subject to another and their interrelationships have a great role for maximum understanding of the field to the visitors. One visit to such galleries will make them to learn and remember the stages of developments of this subject namely Materials Science.

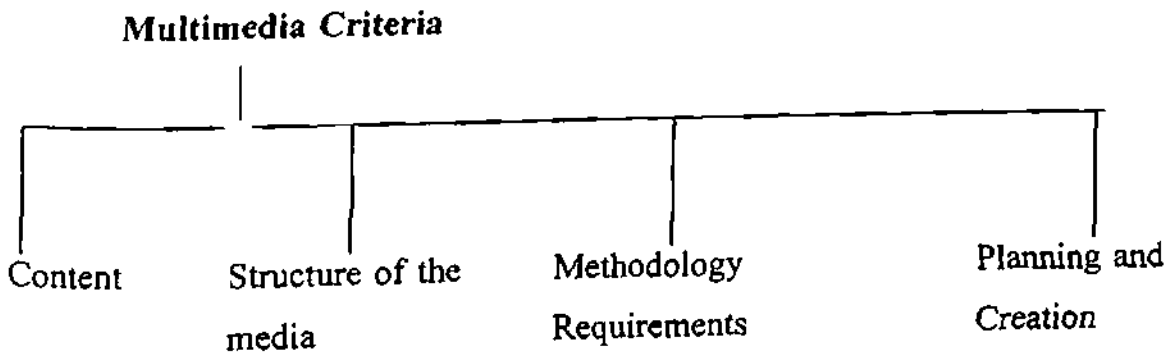
2.0 INTRODUCTION ON MULTIMEDIA CERAMICS AND GLASS

The multimedia system for ceramics and glass consist of :

- a) Criteria for a multimedia
- b) Matrix
- c) Data files
- d) Hardware

A) CRITERIA FOR A MULTIMEDIA

The criteria for a multimedia contains the following :

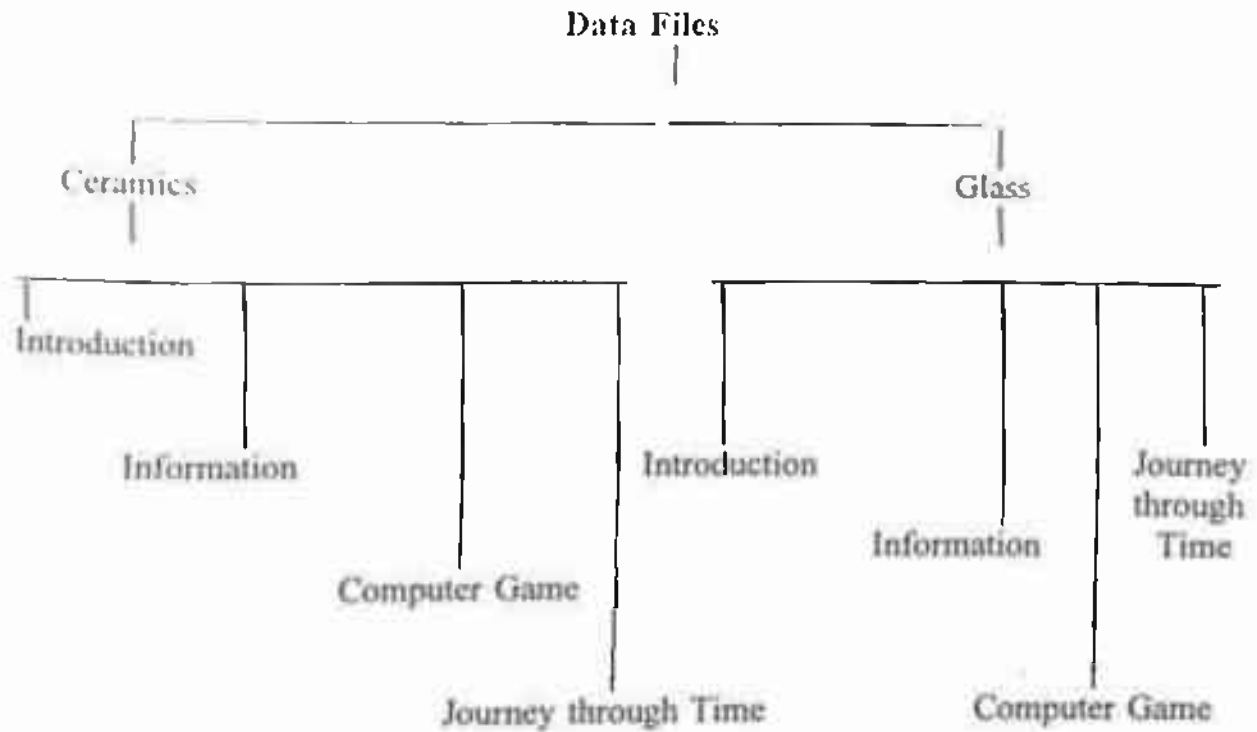


The above details of the aspects are enclosed in Appendix No. 6.

B) MATRIX

A tree-diagram is designed for multimedia Ceramics and Glass with computer game and Journey through time and is shown in the diagram No.1 in Appendix No.6. The contents of the tree-diagrams have been designed and sequenced for the above elements.

C) DATA FILES



D) HARDWARE

The hardware requirements for the multimedia ceramics and glass are explained. Generally the following hardwares may be needed for a multimedia system.

1. IBM compatible Personal Computer
2. Monitor
3. Laser Printer
4. Large Display Monitor

Multimedia Ceramics and Glass

Among the four elements of the Multimedia Ceramics and Glass such as Criteria, Matrix, Data files and Hardware, the tree diagram under Matrix, has been designed and presented in this report and enclosed in Appendix No. 6. In addition to this, an introduction to Criteria for a Multimedia has been vividly prepared and submitted in this report.

Multimedia consists of the following :

1. Criteria pertaining to content
2. Structure of Media.
3. Methodology Requirements
4. Introduction: Criteria for Multimedia- Planning and Creation.

The Planning and Creation of a multimedia script consists of the following levels. :

- a. Creation as a treatment
- b. Script (including management)
- c. Screen design/media processing
- d. Programming
- e. Building of the station/kiosks (parallel to programming)
- f. Implementation
- g. Maintenance and service including contracts with defined personnel resources.
- h. Use of the Multimedia systems out side the museum.

2.1 Methodology adopted in the design of Multimedia Ceramics and Glass :

The first two elements of Multimedia Ceramics and Glass such as criteria and Matrix have been presented and explained. A tree-diagram under Matrix has also been designed and presented in the last report. The tree-diagram of Matrix consists of Ceramics, Glass, Computer game and journey through time. For the above four topics, necessary data files have been created for making a multimedia system and the data files designed for ceramics section has been enclosed in Appendix No. 6 as an example. The main idea is to allow the visitor to select any of the four programmes by a screen-touch and the visitor has full liberty to continue or discontinue in that sequence or he can restart another sequence by his liking.

The main methodology is to give full freedom to the visitors for selection of his choice and learning at his will and pleasure.

The data files explain the following ingredients :

- 1) Sections
- 2) Groups
- 3) Titles
- 4) Sub groups
- 5) Elements
- 6) Audio Text
- 7) Written Text
- 8) Pictures/Text media
- 9) Video / Animation
- 10) Graphics / Animations
- 11) Further Media
- 12) Remarks concerning topics and media
- 13) a. Buttons for operations 1,2,3
- b. Activities / Works
- c. Links
- d. No.of branches
- 14) Remarks for the software

Each data file page consists of the above details. Data files with matrix are enclosed with this report. The hardware details with photographs are also enclosed with this report.

Sequence operations to enter the multimedia

Moving Screen

Before branching into any station the starting screen (0.1) appears on the TV. This screen may be having some animation of leading figure such as Mickey Mouse with text label such as "touch me" Zooming in or Zooming out or collapsing of the text. This is needed for attracting the visitors to make them to touch the screen.

1.0 INTRODUCTION ON COMPUTER SCIENCE GALLERY

INTRODUCTION

Computer Science is one of the modern thrust areas to be seen at every places in the world. This Science, compared to other sciences, has gained its importance due to its rapid changes in its designs & technology and people are finding very much difficult to cope up with updation of the various versions of this technology. The design of the Computer Science Gallery should be based on the above criteria for the present and future generation of the younger people.

In connection with the above design aspects, one should remember the following three components.

1. Visitors should not get bored with a lot of computer PCs spread over the gallery.
2. Visitors will realize the importance only if they go through the computer monitor (i.e. if they sit in front of the computer and do the things).
3. It is advisable or preferable that the relevant applications or objects known to the visitors have to be taken as examples for explaining the Computer systems.

The study on such a type of Computer Science Gallery may be consisting of different departments such as computer elements, technology of chip, display screens, interaction systems, cryptography, programming, multimedia systems, etc.

A brief tentative design of computer science gallery for a modern Science Centre may be attempted in this independent study.

BROAD CLASSIFICATION OF COMPUTER SCIENCE GALLERY

The major departments or groups of a Modern Computer Science Gallery are broadly classified as follows :

- | | |
|----------------------------|--|
| i. Uses of Computers. | ii. Computer elements. |
| iii. Technology of Chip. | iv. Large screen Displays. |
| v. Interactive System. | vi. Cryptography. |
| vii. Inter's Pentium. | viii. Physical Model of a Chip |
| ix. Programming. | x. Links of Computer system software and hardware. |
| xi. Quantitative Controls. | xii. Multimedia systems. |

The above will have interactive exhibits which will kindle interest in the younger generation for developing technical skills, for acquiring the requisite knowledge, for understanding their applications as well as for utilizing the potentialities of Computers in their day-to-day activities. The brief description of the exhibits of the above categories will be presented in this report.

3.1 DETAILS ON INTERACTIVE EXHIBITS OF COMPUTER SCIENCE GALLERY

1.0 USES OF COMPUTERS

1.1 Robotics

- a. Control the robots by computer, e.g building a tower with stones from a box as per the coordinates of source and destination (x,y and z-coordinates) in 3 dimensions.
- b. Robots picking up the correct figured objects from the screen drawn by the visitor. Here visitor can use mouse and draw the geometrical shapes.
- c. Computer manipulations with robots.
- d. Robots - to analyse the axes, grip force (e.g an egg: it is necessary to hold but not to destroy it (testing tolerance)).

1.2 Designing a book

The Visitor can design a book on a letter pad.

1.3 Graphic programs :

Computer Tomography - explaining the slices of complicated structure of the brain (may be a comparison between an animal and a man).

1.4 Calculating calendar

Visitors can find the day a particular date of the year (e.g. visitors' birthday).

2.0 COMPUTER ELEMENTS

2.1 Hardware

- a. Open a computer and show the main parts like CPU, Memory and I/O devices.
- b. Screen or monitor of different sizes (5 to 10).
- c. Different mouses
- d. Different systems of key-boards: why there are different key-boards in different countries? - their problems.
- e. Different printers and plotters.

The most important thing is that the visitors must use the hardware directly and feel it.

2.2 Software

- a. Large floppy disc model: The visitors are asked to walk over and learn that software on floppy disc.
- b. Different softwares work on the same hardware.
- c. Software can change the machine.
- d. Only software completes the computer machine - i.e. computer without software is not possible.
- e. Several floppies can show different functions which the same computer performs.
- f. Softwares controlling the screen of the monitor.
Visitors are asked to draw a point or a line or make a colour or change a colour from one to another and so on.
- g. Softwares controlling the printer - same as above.
- h. Softwares controlling the key - board. It has been programmed such that for example, a key-say A-can be used to represent as A or a or asked to draw a circle or any *standard geometrical figures*.
- i. Softwares controlling the FDC-floppy disc controller. Different operating systems such as read, write, copy, format - and edit-commands of DOS (Disc Operating System) can be lively demonstrated to the visitors.

3.0 Technology of CHIPS

3.1 History of the birth of Microchips from 1970 to 1996

3.2 Glimpses of Microelectronics

Semiconductor memories, microprocessor chips, single chip system, single chip microcontroller, sensors in microelectronics, active elements in microelectronics, single board micro computer (SBC), assembly of printed circuit boards (PCB), application of microelectronics, digital technology replaced analog devices, cash dispensers and chip cards, microelectronics in automobiles and motor car electronics (e.g anti skid control, ABS control unit), digital ignition control, microelectronics in entertainment and leisure, the automated factory, microelectronics in medicines, computing; knowledge based systems and so on.

3.3 In-line-production :

The Visitor can get a non running machine and he should repair a machine through monitor information. Feedback means the running of the machine.

4.0 Large Screen System

This can be in the front part of the gallery and one or two in the other places, too. This interactive model is controlled by the computer and computer helps the visitors and all the visitors can look on and admire and get thrilled to enter gallery.

5.0 Interactive System

5.1 Computer games

At least 10 to 15 games can be introduced. All may be new and museum oriented (no commercial games).

5.2 Navigation System

5.3 Prime numbers

6.0 Cryptography

It is the science of secrets. Here different coding systems (Encoders and Decoders) can be explained. The visitors are asked to encode a message of 3 to 6 words and try to retrieve the message through a decoder and so on.

The visitor should solve a riddle - Cross word - or build his own coded riddle which will be decoded by his friends.

7.0 Intel's Pentium

Display of the chip - Intel's Pentium with the details.

8.0 Physical Model of a chip

A gigantic model of a chip through which visitors can enter, walk and feel the working of a micro chip (ref. Boston's Computer Museum, Boston USA).

9.0 Programming

9.1 Languages based on applications

- | | |
|--|---------------------------------------|
| a. Writing a sentence | b. Making a graphic |
| c. Controlling a simple robot | d. Controlling a technical instrument |
| e. Controlling a business transaction. | |

10.0 Links Between hardware and software

- | | |
|---|---------------------|
| a. Memory Management System (MMS) | |
| b. Memory mapping and addressing, dynamic processing. | |
| c. Programs in the memory | d. Operating system |

11.0 Quantitative Controls

- a. Development of computer : old vs present generation system
- b. Comparison amongst memories (e.g. capacities): old vs present generation system
- c. Punched card system vs the Floppy (quantitative aspects)
- d. Importance of the memory for the programs.

12.0 Multimedia - Systems

It is an interactive system with a close connection to the topics in the gallery. All the Computers in the gallery must be used as part of an integrated Multimedia - System of the gallery.

Conclusion

In essence, it can be concluded that computers are newer and becoming newer and newer machines in exploring their ways into engineering, science and business, e.g. Program - controlled calculating and data processing machines.

Computers operate electronically and owe their success to microelectronics. Computers, with their manifold capabilities, have universal applications. They free man from monotonous brain work and have revolutionized the world of human labour. They can solve differential equations, carry out book - keeping, guide spaceships, control chemical processes and communicate messages or play chess (whether human race wins against computer or reverse).

In each of the above cases, computers process information. The Science that explains their design, construction and the way they work and also masters the art of programming, is called Computer Science. Computers operate independently to an extent previously unknown in machines. Program control provides them with universal abilities in automation.

CHAPTER - V

V. PART - IV NATIONAL COUNCIL OF SCIENCE MUSEUMS

1.0 Evaluation & Assessment of the Reaction of Visitors in the three Science Centres of National Council of Science Museum (NCSM).

1.1 Introduction

Recalling the work done by Randel F. Washburne⁷ and J. Alan Wager⁷, "as an initial step in evaluating the effectiveness of interpretation, a study was undertaken to investigate visitor's responses to exhibits in four Science Centres in the Pacific Northwest" ; also Recalling their methods of study, "in each of the centres, visitor's were interviewed after they had seen an interpretation, which included exhibits, dioramas, relating to the science. Interviews were conducted with the randomly selected visitors aged 15 and older. During these interviews, each visitor was asked to select the exhibit he found to be the most interesting".

In continuation with the study for evaluation and assessment of the visitors and their groups to the Science Centres on par with the above authors, the collection of data from the following three Science Centres from NCSM has been carried out from September 98 to December 98 from the varied visitors numbering 200 from each.

1. District Science Centre (DSC), Tirunelveli, Tamil Nadu
2. Regional Science Centre (RSC), Tirupathi, Andhra Pradesh
3. Visvesvaraya Industrial & Technological Museum (VITM), Bangalore, Karnataka.

VITM, Bangalore is one of the famous renowned Science & Technology Museums established by National Council of Science Museums. In the past 25 years of its existence, NCSM has established in VITM, various halls of Science & Technology of different themes such as Popular Science, Timber, Paper and Metal, Motive power. Now NCSM has introduced innovative galleries such as Electrotechnic, Engine Hall, Fun Science and Children's Science gallery. Among all the Science Museums in India, it attracts maximum number of mixed visitors from various regions of India and Abroad.

Regional Science Centre (RSC) at Tirupathi has been introduced into public only 5 years before by NCSM, Calcutta. Being situated at the foothills of Tirumala, it is attracting many pilgrims going to Tirumala towards it. It has modern scintillating galleries such as Motion, Fun science, Children's Science and Science Park.

The District Science Centre at Tirunelveli of Tamil Nadu is one of the gems of Science Museums of NCSM. For the past one decade, it has propagated Science and Technology to the rural students & general public of Tamil Nadu via Treasures from Ocean, Oceanic Quest, Popular Science and Science Park.

Three different levels of Science Museums have been chosen for this study so that the effect of visitors over the science museums can be distinctly measured and evaluated. As the researcher has already completed the evaluation of Chennai Science Centre, the data from Chennai Science Centre is also given along with these above museums for the sack of comparison.

The questionnaire is of the same type as carried out for Tamil Nadu Science and Technology Centre, Chennai. It consists of 3 parts such as On Science Centres (Part A), On Learning Styles (Part B) and On Science Exhibits (Part C). Questions on Science Centre deal with the infrastructure facilities of the Science Centre. While the questions on Learning Styles study the psychological behaviour of children and public inside the halls of science. The last part on Science exhibits reveals their understanding power of exhibits.

1.1. Methodology

The methodology adopted in this evaluation is to analyse the visitor's responses to various factors such as on the infrastructural facilities of Science Centres, on learning styles of the visitors and on the exhibit contents. As per the views of the authors Randel F. Washburne⁷ and J. Alan Wagar⁷, this methodology depends upon solely on an initial step in evaluating the effectiveness of interpretation. In this regard, a study has been undertaken to investigate the visitor's responses to exhibits in four Science Centres in the South India.

In each of the centres, visitors were interviewed through the circulation of questionnaire and by verbal discussion and observation after they had seen an interpretation, which included exhibits, dioramas etc., relating to the Science and Technology. Circulation of Questionnaire and interviews were conducted with the randomly selected visitors aged 15 and older. During the collection of data and interviews, each visitor was asked to select the exhibit he found to be the most interesting. The outcomes of this interview are analysed and tabulated with the results.

The questionnaire containing 3 parts have been circulated to the various visitors of Science Centre at Tirunelveli, Tirupathi and Bangalore and received data. The data thus collected have been studied and fed to the computer for plotting histograms, pie-charts and tables. They are enclosed in Appendix No.08 with their explanations. The following are the inferences derived from these results. The histograms & tables in this Appendix No .08 combines all the four Science Centres under study.

1.2 Demographic Details

The Tirunelveli demographic details reveal that the data has been collected for this Questionnaire on Science Centres from maximum number of students or children than adults. (85% of children and 15% adults). About sex, male (62%) dominates over female (38%). The educational qualifications indicate that 49% are below +2 levels, 51% are graduates. Most of the visitors are from Tamil Nadu. The above details have been tabulated in Table : D1 of Appendix No.8. Collectively, it can be said that the visitors who gave their views on Science Centre are of children or students of Tirunelveli. This Table : D1 also contains the details of visitors who have visited other Science Centres.

In case of Regional Science Centre, Tirupathi, 80% of the Visitors are of students. About sex, male (94%) dominates over female which is only 6%. The educational qualifications indicate that 62% of the people are below graduation. Most of the visitors (88%) are from local regions. Unemployed (84%) are visiting maximum compared to employed. This is almost in comparison with DSC, Tirunelveli.

2 The maximum participation of Adults (47%) and (66%) in VITM, Bangalore and TNSTC, Chennai is clearly seen as distinct feature compared to DSC and RSC. Maximum number of visitors are educated in Chennai (76%) and Bangalore (62%) i.e. more than graduate level. They expected more to learn inside the Science Centre. Instead of local people, maximum of outsiders visit VITM (66%) and TNSTC (56%). This is due to the fact that the Science Centres are centered in main capitals of the states. Also Employed are in many both in VITM (64%) and Chennai (63%).

There is a distinct demarcation of visitors between the capital Science Centres, DSC and RSC. Growing tendency of the educated masses to visit Science Centre is developing in capital Science Centres. While the rural population visit DSC & RSC. Demographic details vividly exhibit the attitude of locals and other towards Science Centres.

Referring the important conclusions of the author Judy Diamond¹⁰ on sex differences in Science Museum, it is felt that involvement of girls and women is found to be of minimal quantity compared to the male. This can be seen from the demographic data (Refer Table D1) that only 6% to 38% of the interviewed Female visitors were participating in the activities of Science Centres.

As per the views of Judy Diamond¹⁰ that "girls as a group have far fewer Science and Math - related experiences than boys. This article reviews what is known about how these differences carry over into Science Museums. Behavioural studies indicate that girls generally engage in more cooperative behaviour at Museum exhibits and boys explore exhibits more actively on their own. However, there are large differences between institutions and even discrepancies between similar studies at the same institution.

Museums or Science Centres may be able to minimize gender differences by anticipating them in the design of exhibits and programs".

From the above passage, it is clear also from our data that less participation of female gender contributes due to the lack of S & T experiences in the girls and women population.

1.3 Part A

On Science Centre

From the quote of Klaus von Dohnanyi as "Museums or science centres must be organised so as to invite a wide public. Eventhough about 90% of the population has been at least once in a museum, about 40% attended museums only during their school time. I would personally believe that a certain amount of easy improvisation would keep the museum better to establish continuous connections with the general public".

This indicates that improvisations like temporary exhibitions, news coverage, advertisements and other facilities are to be done by the museum authorities to attract the general public. That is, influence to visit science museum, must be analysed in the context of the above quote. The following inference that news items attract the visitors to the science centres is to be correlated with the above view point. Similarly other following factors may be related to the above author's thoughts.

The Part A consists of fourteen Questions dealing with the influence to visit Science Centre, seeking for knowledge or entertainment, visiting timings, facilities, exposition of science galleries & exhibits and the suggestions of visitors.

a) Influence to visit Science Centres

From histogram No.04, of Appendix No.8, the average value reveals that only News items have motivated the visitors to visit the Science Centre. Comparing Science Centres, as shown in the histogram, the influential percentage by Friends stands to the height as 51% in DSC. The next factor is through the News items as 50% in RSC.

b) Seeking for Knowledge or Entertainment

Here 81% of the visitors visit this Centre for seeking knowledge in Science and Technology. The entertainment seekers are only 17%. This attitude in knowledge seekers of this place is in comparison with other centres. So more than 80% of the visitors expect the knowledge to be gained after their visit to the Science Centres. (Refer histogram No.05).

c) Facilities (Q. 06 to 09)

Regarding the visiting timings of the Tirunelveli Science Centre, 85% of visitors prefer the present timing of 11.00 a.m. to 7.00 p.m. Only the remaining 15% have sought for the modification of timings. Comparing all the Science Centre, visitors mostly accepted the stipulated timings of the respective Science Centres (See Average).

Question No.07 deals with the advertisement facilities done by the Science Centres. 87% of the visitors have not seen any advertisement boards of Tirunelveli Science Centre. While in Tirupathi, 58% have seen the advertisement board located near the Alipirigate on the way to Tirumala. In Bangalore, 100% of the visitors have not seen any Advertisement boards in the city. Similarly in Chennai 90% of visitors have not seen advertisement boards. For getting more visitors, advertisement boards may have to be put up in important locations just like Alipiri gate in Tirupathi.

Regarding general civic amenities, visitors to all the four selected Science Centres have given their verdict of more than 70% of acceptance of amenities like toilet, bathrooms, sitting lounges and canteen.

The entry fees for District Science Centre is Rs.2 for adult and Rs.1 for students. 92% of the visitors felt happy about this free structure. The entry fee for Regional Science Centre at Tirupathi is Rs.4/- per head. 78% of the visitors have accepted the above fee. The entry fee at Bangalore is Rs.10 and Rs.5 for adult and child respectively. 92% of the people have accepted the fee structure. Except for 10 to 20% of the people, most of them have agreed with the entry fees. (Refer histogram No.06)

d) On Science Exhibition (Q 10 to 16)

From the histogram No.07, more than 80% of the visitors to all the four Science Centres, were satisfied by the exposure of exhibits in the selected Science Centres. There are some grievances like lack of guides and demonstrators of exhibits. They belong to 10 to 20 percentage. Hence it may be suggested to put more guides in addition to security guards.

On average only 20% of the visitors who visit the Science Centres are not able

to cover all the galleries. This is due to their busy scheduled programmes and other factors. But remaining 80% of the visitors cover all the halls of science. Please refer histogram No.07.

In all the four Science Centres, more than 95% of the visitors have accepted that the Science Centres arouse curiosity among the children for learning science. (Please refer histogram No.08). Nearly 90% of the visitors in all the four science centres have agreed to the concept of out-door display of exhibits namely Science Park concepts. (Refer histogram No.08).

From the lowest 55% (at Tirunelveli) to the highest of 72% (at VITM, Bangalore), visitors preferred the Science Centre as equivalent to other visiting Places for entertainment. While nearly 80% of the visitors in all Science Centres consider the Science Centre as a repertoire of knowledge or learning Centre (Refer histogram No.09).

Visitors are able to adjudge themselves about the best attractive exhibit among all the galleries of the respective Science Centres. This indicates their capacity to visualise the judgement decision on science exhibits.

General suggestion from the visitors are like maintenance of science exhibits, introduction of new latest exhibits like Space Science, Information Technology etc, and prevalence of silence in the galleries for concentration (i.e. not needing noisy atmosphere in the galleries) and better explanation through lables and providing ample guides.

Not much of out-reach programmes conducted by Science Centres have reached the people. This is indicated from their Opinions in the questionnaire.

The above histograms and table :DI contribute the part A details of the four science centres.

1.4 Part B

On Learning Styles

As mentioned by Judy Diamond², Director, International environmental studies, world college west, San Rafael, California that "the science museum is setting where people can learn about science and then share their experiences with family, friends and even strangers. This sharing and the social circumstances that comprise it form an essential part of the learning process in the museum".

He has also quoted the importance of the study of visitor's learning styles either individually or in group in science museums as "there is much to learn from the detailed study of science museum visitors. Not only does this help us to better understand how the science museum serves as a resource for learning in our society, but we gain important insight into the mechanisms by which public learning occurs".

In this context, the behavioural aspects of the visitors to the Science Centre at Chennai has already been carried out and analysed. (Please refer the details in section 2.3 and appendix No.3). Now the researcher has collected data from various visitors of other geographical locations such as Tirunelveli, Tirupathi and Bangalore where such Science Centres exist.

The collected data from the above 3 Science Centres of different levels such as District, Regional and National has been processed for statistical analysis. The part B, of the Questionnaire consists of eleven questions from Q.No.18 to 28, dealing with the professional levels of visitors, their learning strength, expected environment, needed companion, expected background in the galleries, preferred visiting time, motivation, needed structures, liking operation of exhibits and assessment of science Centre.

The percentage values of the learning styles in Science Centres have been indicated in Table: L of Appendix No.8 for all the four Science Centres including the Science Centre of Chennai. Their pie-charts are also shown in the Appendix No.8. taking the Average values of all the four Science Centres.

From table L and Pie charts, the following are the inferences about the learning styles of the visitors.

a) Professional Level

Visitors are mostly oriented with the popularisation of S & T as their professional experiences. The average percentage is 51.4% among all the four science centres. The next rank is that of management (21.6%). This shows that the science Centre's aim which is the popularisation of S & T to common man is justified. This is in tune with John R. Hensly⁵ that "part of the science centre's mission is to translate the concepts, basic principles and application of S & T".

b) Learning Strength

The rankings in this category are reading and writing (39.2%), seeing and hearing (30%), and do it yourself (25%). The visitors have given importance for reading and writing. Students population read the labels and texts of the exhibits and tried to understand the exhibits by seeing and hearing.

As per the remarks of the author namely Paulette M. Mcmanus communications consultant, the labels carry more weight in communication with visitors. His finding are that "visual observation of the reading of 583 visitors group was made at the five exhibits. Singletons, 144 of the 583 were considered as groups of one. Almost half of the group (48.4%) were observed as not having any member to read an exhibit text". From our data, 32.9% have observed reading and writing the labels while the remaining 60.8% have concentrated on other aspects. Thus it requires to improve the labels and texts in their placements and as well as in good language.

c) Concentration

The visitor's liking to concentrate in galleries lies in regular concentration (53.7%). More than 50% of visitors prefer regular seeing of exhibits. The next rank goes for continuous observation (25%). This indicates that the disciplined behaviour of learning persists among the visitors.

d) Environment

Visitors expect an environment of relaxed condition (49.1%) and silent atmosphere (31.7%) in the galleries while seeing the exhibits. The relaxed environment means that learning and sharing experiences with family, friends, and even strangers as mentioned by noted author Judy Diamond. The visitors prefer a relaxed environment where they can learn, exchange and share their knowledge about the exhibits. Forceful learning is not required by the visitors.

e) Companion

Visitors need their friends as companion in learning inside the galleries (53.5%). The next companion group is the family group (19%). Thus the friends and family group are the important sections of the population to be approached by the museum authorities for the more participants. The above phenomena is vividly projected by Judy Diamond in his article as "the science museum is setting where people can learn about science and then share their experience with family, friends, and even strangers. This sharing and the social circumstances that comprise it form an essential part of the learning process in the museum.

There is substantial evidence that social interactions between visitors may be important in stimulating learning at exhibits. Visitors commonly arrive at science museums in groups that remain in close proximity, and they provide a continuous and extensive reciprocal influence on their exhibit interactions. Teaching occurs as a fundamental aspect of these spontaneous interactions of family members in science museum. It is utilised as an aid to learning".

f) Background

While the visitors are moving in the galleries, they except a light background music than the noisy atmosphere (42.5%). Also they have a preference of working sound of exhibits (33.1%). Thus a background of light music synthesised with the standard sounds of the exhibits is the proper back up required by the visitors.

Background music and working sound (tunes) of exhibits create stimuli which is one of three elements such as stimuli, subjects and strategies of communication in the visitor's mind to see the exhibits. This point has been supported by the authors Randel F Washburne⁷ and J. Alamwagar⁷ while they have evaluated visitor's response to exhibit content. Under stimulus, one can have motion pictures, changing lighting, music, audio sequence, scale objects, paintings and drawings. Among these, music lighting, audio sequence create much impact on visitors.

g) Visiting time preference

Visitors prefer mostly morning time to visit science centres (46.7%). Time preference is needed to be analysed with respect to location of science Centre in different geographical conditions.

h) Motivation

About 77.7% of the visitors were motivated through self realisation. This indicates that self motivated visitors visit the science centres of often. The next 12.8% the visitors were motivated to come and learn in the science centres through their parents.

i) Structures of Exhibits

About 67.2% of visitors prefer the modular structure of the exhibits. The remaining people prefer to have other structures. The aesthetic look and appearance of the exhibits are enhanced by the modular shape.

j) Operation of Exhibits

As most of the science exhibits cannot be easily understandable by ordinary public, they expect the demonstration to be done by the special guides or explainers or even curators or educational assistants. Demonstration is preferred by the 50% of the visitors.

k) Assessment of Science Centres

About 48.2% visitors from our sample have assessed the science centres as good. This should indicate that the visitors found that science centres is a free place of learning about the modern things which they cannot understand elsewhere.

To increase further their preference, the author Klauss Von Dohnanyi¹¹ has suggested the following facts.

- 1) science museums must be organised so as to invite a wider public.
- 2) science museums must try to get into the curriculum of schools and other institutes of learning

3) the particular potential for a direct confrontation with reality in the museum should be exploited to show the interdependent of social developments. Museums of natural history, for example, must deal with the current problems of environment.

(ie) there is a greater demand for such interdisciplinary exhibitions, since everybody feels that we have lost the potential to see the totality of life.

4) science museum must reach all regions in the country - directed towards decentralisation ie. towards regionalization - directed towards cooperation between museums - avoiding duplications of exhibits.

5) Museum must turn more from an introverted to an extroverted policy.
(ie) museums have to deal more clearly with the problems of exhibition techniques.

1.4.1 Satisfaction Functions in Visitor's Learning Trends for all the four Science Centres (Refer Graph No.1 in Appendix No.08)

The researcher, in addition to his above observations and works, has made a graph on eleven satisfaction functions of the visitor's learning trends for all the four Science Centres including 3 of the National Council of Science Museums. The average values of the four Science Centres have been calculated and given as in Table: G1.

From the Table : G1, data on number of persons satisfied, cumulative number of persons and cumulative percentage, it is inferred that 60% of their satisfaction comprise the six attributes from A to F such as, self motivation, modular structure, regular concentration, friends as companion, relaxed environment and popularisation of S&T. The remaining five satisfaction factors from G to K such as self operation, good

assessment morning time preference, light background music and reading/writing cover the remaining 40%. The building of Science Centres is to be in tune with the visitor's learning style as referred from A to F.

1.4.2 Dissatisfaction Functions of visitors towards science centres (Refer graphs G2 to G5)

As the dissatisfaction functions of the visitors vary in the selected four science centres, the researcher has tabulated separately the data collected for the four science centres in tables G2 to G5 for VITM Bangalore, DSC, Tirunelveli, RSC, Tirupathi, TNSTC, Chennai respectively. The corresponding graphs (graphs G2 to G5) are also plotted for each of the above centres.

Table G2 and Graph G2 depict that the 90% of the dissatisfaction levels in VITM Bangalore comprise the functions from A to E such as advertisement, recreation, civic amenities, new concepts and exposition of exhibits. The remaining 10% of the dissatisfaction prevails on F to I such as science park, entry fees, visiting timings and curiosity. That is, visitors are dissatisfied mostly with general awareness such as inadequate advertisement, less recreation, lack of civic amenities, less creation of new concepts and poor exposition of exhibits.

While analysing the DSC, Tirunelveli, (Table G3 and Graph G3), the same phenomena exists (ie.) 90% covers the above dissatisfaction factors. Similarly, the other two science centres at Tirupathi and Chennai follow the pattern.

This shows that dissatisfaction functions of the visitors relate to the advertisement, amenities, recreation, new concepts and exposition of exhibits.

1.5 Part C

On Science Exhibits

This part on exhibits has been developed with the aim of getting feedback from visitors on the aspects of the selected science exhibits of different galleries of all the three science centres of NCSM from Bangalore, Tirupathi and Tirunelveli. The VITM, Bangalore has six galleries namely Heart, Engine Hall, Electrotechnic, Fun Science, Timber, Paper & Metals and Popular Science & Children's Science Gallery.

The pattern of galleries in Regional Science Centre, Tirupathi is different from other levels of Science Centres. They are Motion I, Motion II, Fun Science, Children's Science and Science Park. The galleries in District Science Centre, Tirunelveli are on Treasures from Ocean, Oceanic Quest, Popular Science (2 galleries) and Science Park.

The Questions for each gallery allow the visitors to choose an exhibit of the particular gallery and convey the principle of it. Also the attractiveness of the display and understandability of the exhibit have also been included in the questions.

The data statistics of each Science Centre have been tabulated in the Tables C1 to C3.

1.5.1 VITM, Bangalore (Refer Table : C1)

Visitors have been attracted towards Popular Science & Children's gallery and Timber, Paper & Metal for their best display techniques. The next remarks are for Engine hall, Electrotechnic, Fun Science and lastly Heart (which is only of small area).

The 70% of the visitors were able to express the principles of the exhibits of Electrotechnic . This is in prominence with the other galleries. This shows that the Electrotechnic Gallery exhibits expose the principles to the visitors easily.

As referred by John R. Hensley⁷, gallery development director of St. Louis science Centre that "part of the science centre's mission is to translate the concepts, basic principles and applications of S & T. We provide visitors opportunities to enhance their capacity to understand the complexities of S & T", the principle of exhibits in electro technic gallery have been 3-diamonsionalised to visitors for their perspective understanding. Such as galleries have to be created in science centres.

Among the six galleries visitors easily understand the exhibits of Popular Science & Children's Science. They find more difficult to understand Fun Science exhibits. The reason may be that the principle of science has been hidden in the fun science exhibits. That is, the principle is not directly exhibited.

1.5.2 Regional Science Centre, Tirupathi (Refer Table : C2)

Generally, the very attractive galleries for the visitors are Motion II and Fun Science (as seen from Table C2). About 52% of the visitors are able to express the working principles of exhibits of Science Park. Here the Science Park exhibits are well

exhibited in many numbers and neatly maintained. About 90% of the visitors understand easily the exhibits of Fun Science Gallery.

Mostly, display attraction is good is Tirupathi Regional Science Centre. This can be seen from the Average data (95%) by display attraction.

1.5.3 District Science Centre, Tirunelveli (Refer Table : C3)

93% of the visitors are attracted towards the displays due to their best techniques. The difficulty to understand the exhibits arises from the Ocean Quest gallery. About 71% of the visitors, are able to express the principles of the exhibits of popular science. (Energy ball exhibit etc).

1.5.4 Maximum Number of Visitors (From the data of Q.No. 11a)

In VITM, Maximum number of visitors (Above 90%) visited the Engine Hall. The Engine Hall has a lot of important artifacts of Engines and an attractive display of various machines related to mechanical systems.

In District Science Centre, Tirunelveli, maximum 80% of the visitors have visited the gallery namely Ocean Quest. This Ocean Quest has many interactive exhibits such as wave generator, Quiz etc.

In Regional Science Centre, Tirupathi maximum 80% of visitors have visited two Motion galleries which contain many automated exhibits.

1.6 CREATIVITY

On reading the remarks of prof. S.K. Ghose¹², president of ICOM , it is felt that the creativity aspect has to be introduced in the science Centre for the dissemination of scientific knowledge to the common man. In this regard, his quotes such as "most important in a science museum is the elucidation of various theories and the explanation of scientific phenomena with help of specially designed demonstration exhibits. A science museum, therefore, does not live on materials collected from nature alone, but has to create its own exhibits in many cases. Such a creation relates to the events of the past, present and sometimes of the future. Creation does not mean replicas or models are models that can be prepared in any kind of museum if so desired, but to new kinds of exhibits, not existing in nature, but originating in the brain of an ingenious curator or designer for the purpose of translating theoretical ideas into 3 dimensional working exhibits form. This extra scope and facility for creating new exhibits is a vantage point for the dissemination of scientific knowledge in the community".

On the above aspects, the following exhibits were selected by the visitors as creative exhibits in the respective science centres of South India.

1.6.1. The Best Creative exhibits in VITM, Bangalore (from visitor's point of view)

(From the data of Q.No.11b)

- 1) Energy Ball
- 2) Heart ticks off seconds
- 3) Your Weights on different planets

4) How far to the sun

5) Picture phone

1.6.2 Best Creative exhibits in RSC, Tirupathi

1) Energy ball

2) Movements in joints

3) Science park

4) Aquamobile

5) Taramandal

1.6.3 Best Creative exhibits in DSC, Tirunelveli

1) Formation of Waves

2) Electricity from Tides

3) Indian Ocean Floor

4) Earth is sphere

5) Treasures from Ocean

SUMMARY

Questionnaire method of interacting with the visitors has effectively contributed valuable data on the role of S&T centres and its relevance on society. From the results of the data on various topics such as demographic details of visitors, views of visitors on science centres on learning styles visitors and finally on exhibits of the galleries, one can infer the following results.

In a nut-shell, the demographical details from the table D1 depict that more number of male population visit science centres compared to the female. Also in capital city science centres like VITM, many educated people visit science Centre for want of knowledge on modern gadgets. Hence necessary provisions have to be incorporated in science centres for catering to the needs of the educated people also since the education level has been substantially elevated now a days including rural areas.

From the data (Histogram 04 to 08) on science centres, it is clearly felt that the facilities like drinking water, toilet, bathrooms, lounges and canteen have to be made easily available to the visitors. The science centres have to be fully resourceful centres in accordance with the opinions of visitors. Their satisfaction factors should be more than dissatisfaction factors.

The visitors are the customers to science centres. For them, the science centres act like learning centres. Hence the learning styles of the visitors studied in this research such as expected operational facilities, expected environment, sound level and exhibits are essential facts.

The learning styles of the visitors in terms of their levels of concentration, ways of learning such as reading, writing, seeing and hearing, liking of exhibits are studied in this report. Learners want noiseless and light background music background for their learning. This is seen from the data having more than 50% of visitors preferred the music while learning. It means that the visitors learn under relaxed atmosphere. About 30% visitors only used labels and texts of the exhibits. Most of the visitors needed demonstrators or guides in the field of S & T to explain exhibits. For learning, they need companion such as friends group and family group. Hence the authorities of S & T have to approach the groups of the society and make their exhibits suitable for the group satisfaction. Group learning is preferred by the visitors. It is clearly seen from the data of the companion that 50% of visitors are for friends and 40% of visitors are for family. Also family group discussion is based on discussion among the child parent interaction.

On exhibit, the visitors expect the maintenance to be fully done. Creativity criteria is one of the factors, expected in the science centres among the visitors. Their learning style on science exhibits depend upon the aesthetic look and modular structure of the exhibits, quick dissemination of principle of the exhibits and actions of the exhibits which will persist still longer in their stimulus mind.

The exhibits like energy ball (VITM), Aquamobile (RSC, Tirupathi), ocean wave generation (DSC, Tirunelveli) and energy ball (VITM) have provoked the visitors to such an extent that they can never forget to visit science Centre again and again to learn science. South India has generated such valuable science centres like VITM, RSC, DSC created by National Council of Science Museums. Also the activities like temporary exhibition (like INSECTS seen in VITM) create the awareness of the visitors towards science centres for learning on new and innovative items of S & T.

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Appendix No.08

On

"NCSM"

VISVESWARAYA INDUSTRIAL & TECHNOLOGICAL MUSEUM
(National Council of Science Museum, Kasturba Road)
Bangalore - 560 001.

QUESTIONNAIRE

NOTE

1. Kindly strike out the answer which is not applicable
2. Please be brief in you comments/remarks.

This questionnaire has been prepared by Er.R Madhavan, Joint Director of Tamil Nadu Science and Technology Centre, Chennai - 600 025, for surveying the status of Science Centres in Society for his Doctorate Programme. Kindly fill in the following questionnaire (3 parts) and submit it to Er.R.Madhavan.

01. Date
02. a. Name
b. Age
c. Sex
d. Occupation
e. Qualification
03. Where do you come from?
Bangalore Karnataka Other Places (Please Specify)
04. What influenced you to visit the Science Museum and Miniplanetarium?
a. Your children b. Friends c. News items d. Any others
05. Did you come here seeking
a. Entertainment b. knowledge c. Any others
06. a. Are the current visiting timings for Science Centre Convenient for you?
Yes/No
b. If your answer is "NO", please specify the convenient timings for you to visit the Centre including Miniplanetarium.
07. If you have any hoardings (Advertisement Boards) of our Science Centre, please specify the locations.
08. Do you find the civic amenities (i.e. Drinking Water, Canteen, Sitting lounge, Toilet etc.) are adequate in this Campus?

(Please suggest if you need any other additional facilities)

09. Is the entry fee for Science Centre reasonable?

Yes/No

10. a. Do you feel satisfied with the exposition of exhibits?

Yes/No

b. If "NO", offer your remarks for its improvements?

11. a. How many Halls of Science of this Centre have you covered, during your present visit? Please mark the Halls with sign wherever applicable.

b. Which one exhibit of this Science Centre is of exemplary nature? Please mention only one exhibit and give reason for your choice. Highlight your observation.

12. Do you consider that this Science Centre will inculcate in the children, curiosity in Science and improve their knowledge in Science and Technology?

Yes/No

13. How do you compare this Science Centre to other visiting places for

a. Recreation : Comparable / Not comparable

b. Learning concept : Comparable / Not comparable

14. Do you agree with the concept of the outdoor display of exhibits at the Science Park?

Yes/No

15. If you have any idea or methodology which you wish this Centre should incorporate, please mention here

16. Any other suggestions and constructive criticism you wish to bring to our attention.

17. Enlist the most interesting out - reach programme enjoyed by you in the centre? If so, Why?

PART - B ON LEARNING STYLES

18. What is your professional interest?

a. Popularisation of Science & Technology

b. Management/Administration

c. Finance d. Any others (please specify)

19. Your strength in learning lies in?
- a. Do it yourself b. Reading & Writing
c. Seeing & hearing d. Any other (please specify)
20. In what measure, do you prefer to concentrate more inside the galleries for understanding?
- a. Continuous b. Regular
c. Sporadic d. Any others (specify)
21. What mode of Environment do you experience in this Science Centre while going through the galleries?
- a. Under pressure due to constrain b. Noisy
c. Under relaxed condition d. In silence
22. Do you prefer to visit the Science Centre and acquire knowledge by coming
- a. Alone b. With family members
c. With your friend d. With your spouse (if married)
e. With your students (if you are a teacher)
23. Which kind of background do you expect to prevail in a Science Centre for learning?
- a. Light background music b. With people talking
c. Visitors enjoying with laughs and shouts
d. Working Sound of the exhibits
24. At what time you prefer to visit a Science Centre for learning?
- a. Morning (before 12 Noon) b. After lunch (13.00 to 15.00)
c. Evening (After 16.00 hrs) d. Any time
25. What/who motivated you to come and learn in the Science Centre?
- a. Self relisation b. Parents
26. What type of structure of exhibits is preferred by you?
- a. Modular b. Non - Uniform c. Any other (please specify)
27. How do you like to operate the exhibits?
- a. Self Operations b. Demonstrations by explainers
c. Just by observing in static mode d. Any other (please specify)
28. What is your assessment of this Science Centre for learning in informal way?
- a. Good b. Above average c. Satisfactory d. Poor

**PART - C
ON EXHIBITS**

29. Which exhibit of the following galleries did not convey much scientific content? Please mention only one in each gallery with your brief comments.

30. Choose an exhibit of each gallery, name it and answer the followings:

A. Name of the gallery : Heart gallery
 Name of the exhibit : _____
 a. This exhibit conveys _____ Principle.
 b. Whether the presented display is attractive? Yes/No
 c. Whether the exhibit is understandable? Difficult / Easy

B. Name of the gallery : Engine Hall
 Name of the exhibit : _____
 b. Whether the presented display is attractive? Yes/No
 c. Whether the exhibit is understandable? Difficult / Easy

C. Name of the gallery : Electrotechnic
 Name of the exhibit : _____
 a. This exhibit conveys _____ Principle.
 b. Whether the presented display is attractive? Yes/No
 c. Whether the exhibit is understandable? Difficult / Easy

D. Name of the gallery : Fun Science
 Name of the exhibit : _____
 a. This exhibit conveys _____ Principle.
 b. Whether the presented display is attractive? Yes/No
 c. Whether the exhibit is understandable? Difficult / Easy

E. Name of the gallery : Timber, Paper & Metals
 Name of the exhibit : _____
 a. This exhibit conveys _____ Principle.
 b. Whether the presented display is attractive? Yes/No
 c. Whether the exhibit is understandable? Difficult / Easy

F. Name of the gallery : Popular Science & Children' Science
 Name of the exhibit : _____
 a. This exhibit conveys _____ Principle.
 b. Whether the presented display is attractive? Yes/No
 c. Whether the exhibit is understandable? Difficult / Easy

Visitor's Signature

REGIONAL SCIENCE CENTRE
(National Council of Science Museum, Near Alipiri Gate)
Tirupathi - 517 507.

QUESTIONNAIRE

NOTE

1. Kindly strike out the answer which is not applicable
2. Please be brief in you comments/remarks.

This questionnaire has been prepared by Er.R.Madhavan, Joint Director of Tamil Nadu Science and Technology Centre, Chennai - 600 025, for surveying the status of Science Centres in Society for his Doctorate Programme. Kindly fill in the following questionnaire (3 parts) and submit it to Er.R.Madhavan.

01. Date
02. a. Name :
b. Age :
c. Sex :
d. Occupation :
e. Qualification :
03. Where do you come from?
Bangalore Karnataka Other Places (Please Specify)
04. What influenced you to visit the Science Museum and Miniplanetarium?
a. Your children b. Friends c. News items d. Any others
05. Did you come here seeking
a. Entertainment b. knowledge c. Any others
06. a. Are the current visiting timings for Science Centre Convenient for you?
Yes/No
b. If your answer is "NO", please specify the convenient timings for you to visit the Centre including Miniplanetarium.
07. If you have any hoardings (Advertisement Boards) of our Science Centre, please specify the locations.
08. Do you find the civic amenities (i.e. Drinking Water, Canteen, Sitting lounge, Toilet etc.) are adequate in this Campus?
(Please suggest if you need any other additional facilities)

09. Is the entry fee for Science Centre reasonable?
Yes/No
10. a. Do you feel satisfied with the exposition of exhibits?
Yes/No
b. If "NO", offer your remarks for its improvements?
11. a. How many Halls of Science of this Centre have you covered, during your present visit? Please mark the Halls with sign wherever applicable.
b. Which one exhibit of this Science Centre is of exemplary nature? Please mention only one exhibit and give reason for your choice. Highlight your observation.
12. Do you consider that this Science Centre will inculcate in the children, curiosity in Science and improve their knowledge in Science and Technology?
Yes/No
13. How do you compare this Science Centre to other visiting places for
a. Recreation : Comparable / Not comparable
b. Learning concept : Comparable / Not comparable
14. Do you agree with the concept of the outdoor display of exhibits at the Science Park?
Yes/No
15. If you have any idea or methodology which you wish this Centre should incorporate, please mention here
16. Any other suggestions and constructive criticism you wish to bring to our attention.
17. Enlist the most interesting out-reach programme enjoyed by you in the centre? If so, Why?

**PART - B
ON LEARNING STYLES**

18. What is your professional interest?
a. Popularisation of Science & Technology
b. Management/Administration
c. Finance
d. Any others (please specify)

19. Your strength in learning lies in?
- a. Do it yourself b. Reading & Writing
c. Seeing & hearing d. Any other (please specify)
20. In what measure, do you prefer to concentrate more inside the galleries for understanding?
- a. Continuous b. Regular
c. Sporadic d. Any others (specify)
21. What mode of Environment do you experience in this Science Centre while going through the galleries?
- a. Under pressure due to constrain b. Noisy
c. Under relaxed condition d. In silence
22. Do you prefer to visit the Science Centre and acquire knowledge by coming
- a. Alone b. With family members
c. With your friend d. With your spouse (if married)
e. With your students (if you are a teacher)
23. Which kind of background do you expect to prevail in a Science Centre for learning?
- a. Light background music b. With people talking
c. Visitors enjoying with laughs and shouts
d. Working Sound of the exhibits
24. At what time you prefer to visit a Science Centre for learning?
- a. Morning (before 12 Noon) b. After lunch (13.00 to 15.00)
c. Evening (After 16.00 hrs) d. Any time
25. What/who motivated you to come and learn in the Science Centre?
- a. Self realisation b. Parents
26. What type of structure of exhibits is preferred by you?
- a. Modular b. Non - Uniform c. Any other (please specify)
27. How do you like to operate the exhibits?
- a. Self Operations b. Demonstrations by explainers
c. Just by observing in static mode d. Any other (please specify)
28. What is your assessment of this Science Centre for learning in informal way?
- a. Good b. Above average c. Satisfactory d. Poor

**PARCT - C
ON EXHIBITS**

29. Which exhibit of the following galleries did not convey much scientific content? Please mention it each gallery with your brief comments.

- a. Motion I b. Motion II c. Fun Science
d. Children's Science e. Science Park

30. Choose an exhibit of each gallery, name it and answer the followings

A. Name of the Gallery : Motion I
Name of the exhibit : _____
a. This exhibit conveys _____ Principle Yes / No
b. Whether the presented display is attractive? _____
c. Whether the exhibit is understandable? _____ Difficult / Easy

B. Name of the Gallery : Motion II
Name of the exhibit : _____
a. This exhibit conveys _____ Principle Yes / No
b. Whether the presented display is attractive? _____
c. Whether the exhibit is understandable? _____ Difficult / Easy

C. Name of the Gallery : Fun Science
Name of the exhibit : _____
a. This exhibit conveys _____ Principle Yes / No
b. Whether the presented display is attractive? _____
c. Whether the exhibit is understandable? _____ Difficult / Easy

D. Name of the Gallery : Children's Science
Name of the exhibit : _____
a. This exhibit conveys _____ Principle Yes / No
b. Whether the presented display is attractive? _____
c. Whether the exhibit is understandable? _____ Difficult / Easy

E. Name of the Gallery : Science Park
Name of the exhibit : _____
a. This exhibit conveys _____ Principle Yes / No
b. Whether the presented display is attractive? _____
c. Whether the exhibit is understandable? _____ Difficult / Easy

Visitor's Signature

DISTRICT SCIENCE CENTRE
(National Council of Science Museum, Kokkirakulam)
Tirunelveli - 627 008.

QUESTIONNAIRE

NOTE

1. Kindly strike out the answer which is not applicable
2. Please be brief in your comments/remarks.

This questionnaire has been prepared by Er.R.Madhavan, Joint Director of Tamil Nadu Science and Technology Centre, Chennai - 600 025, for surveying the status of Science Centres in Society for his Doctorate Programme. Kindly fill in the following questionnaire (3 parts) and submit it to Er.R.Madhavan.

01. Date
02. a. Name :
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c. Sex :
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e. Qualification :
03. Where do you come from?
Bangalore Karnataka Other Places (Please Specify)
04. What influenced you to visit the Science Museum and Miniplanetarium?
a. Your children b. Friends c. News items d. Any others
05. Did you come here seeking
a. Entertainment b. knowledge c. Any others
06. a. Are the current visiting timings for Science Centre Convenient for you?
Yes/No
b. If your answer is "NO", please specify the convenient timings for you to visit the Centre including Miniplanetarium.
07. If you have any hoardings (Advertisement Boards) of our Science Centre, please specify the locations.
08. Do you find the civic amenities (i.e. Drinking Water, Canteen, Sitting lounge, Toilet etc.) are adequate in this Campus?
(Please suggest if you need any other additional facilities)

09. Is the entry fee for Science Centre reasonable?
Yes/No
10. a. Do you feel satisfied with the exposition of exhibits?
Yes/No
b. If "NO", offer your remarks for its improvements?
11. a. How many Halls of Science of this Centre have you covered, during your present visit? Please mark the Halls with sign wherever applicable.
b. Which one exhibit of this Science Centre is of exemplary nature? Please mention only one exhibit and give reason for your choice. Highlight your observation.
12. Do you consider that this Science Centre will inculcate in the children, curiosity in Science and improve their knowledge in Science and Technology?
Yes/No
13. How do you compare this Science Centre to other visiting places for
a. Recreation : Comparable / Not comparable
b. Learning concept : Comparable / Not comparable
14. Do you agree with the concept of the outdoor display of exhibits at the Science Park?
Yes/No
15. If you have any idea or methodology which you wish this Centre should incorporate, please mention here
16. Any other suggestions and constructive criticism you wish to bring to our attention.
17. Enlist the most interesting out - reach programme enjoyed by you in the centre? If so, Why?

**PART - B
ON LEARNING STYLES**

18. What is your professional interest?
a. Popularisation of Science & Technology
b. Management/Administration
c. Finance
d. Any others (please specify)

19. Your strength in learning lies in?
- a. Do it yourself b. Reading & Writing
c. Seeing & hearing d. Any other (please specify)
20. In what measure, do you prefer to concentrate more inside the galleries for understanding?
- a. Continuous b. Regular
c. Sporadic d. Any others (specify)
21. What mode of Environment do you experience in this Science Centre while going through the galleries?
- a. Under pressure due to constrain b. Noisy
c. Under relaxed condition d. In silence
22. Do you prefer to visit the Science Centre and acquire knowledge by coming
- a. Alone b. With family members
c. With your friend d. With your spouse (if married)
e. With your students (if you are a teacher)
23. Which kind of background do you expect to prevail in a Science Centre for learning?
- a. Light background music b. With people talking
c. Visitors enjoying with laughs and shouts
d. Working Sound of the exhibits
24. At what time you prefer to visit a Science Centre for learning?
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c. Evening (After 16.00 hrs) d. Any time
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- a. Self relisation b. Parents
26. What type of structure of exhibits is preferred by you?
- a. Modular b. Non - Uniform c. Any other (please specify)
27. How do you like to operate the exhibits?
- a. Self Operations b. Demonstrations by explainers
c. Just by observing in static mode d. Any other (please specify)
28. What is your assessment of this Science Centre for learning in informal way?
- a. Good b. Above average c. Satisfactory d. Poor

**PARCT - C
ON EXHIBITS**

29. Which exhibit of the following galleries did not convey much scientific content? Please mention it each gallery with your brief comments.

- a. Treasures from Ocean b. Oceanic Quest
c. Ground floor Popular Science Gallery
d. Ist floor Popular Science gallery e. Park exhibits

30 Choose an exhibit of each gallery, name it and answer the followings

- A. Name of the Gallery : Treasures from Ocean
Name of the exhibit :
a. This exhibit conveys _____ Principle
b. Whether the presented display is attractive? Yes / No
c. Whether the exhibit is understandable? Difficult / Easy
- B. Name of the Gallery : Oceanic Quest
Name of the exhibit :
a. This exhibit conveys _____ Principle
b. Whether the presented display is attractive? Yes / No
c. Whether the exhibit is understandable? Difficult / Easy
- C. Name of the Gallery : Ground floor Popular Science Gallery
Name of the exhibit :
a. This exhibit conveys _____ Principle
b. Whether the presented display is attractive? Yes / No
c. Whether the exhibit is understandable? Difficult / Easy
- D. Name of the Gallery : Ist floor Popular Science gallery
Name of the exhibit :
a. This exhibit conveys _____ Principle
b. Whether the presented display is attractive? Yes / No
c. Whether the exhibit is understandable? Difficult / Easy
- E. Name of the Gallery : Park exhibits
Name of the exhibit :
a. This exhibit conveys _____ Principle
b. Whether the presented display is attractive? Yes / No
c. Whether the exhibit is understandable? Difficult / Easy

Visitor's Signature

LEARNING STYLES

TABLE : I.

Q. No.	Name of Science Centre	Category Columns					Study Subject
		a	b	c	d	e	
18.	DSC	40.0	25	12.5	22.5		Professional level
	RSC	54.0	20	12.0	14.0		
	VITM	59.5	16.3	13.5	10.7		
	TNSTC	52.5	25	11.5	11		
	Average	51.4	21.6	12.4	14.6		
19.	DSC	14.3	50	28.6	7.1		Learning Strength
	RSC	28.8	32.7	32.7	5.8		
	VITM	19.0	48.6	27.0	5.4		
	TNSTC	36.0	27.0	32.0	5.0		
	Average	25.0	39.2	30.0	5.8		
20.	DSC	28.6	51.4	11.4	8.6		Concentration
	RSC	31.1	46.7	22.2	-		
	VITM	22.2	69.5	2.8	5.5		
	TNSTC	32.0	47.0	15.0	-		
	Average	25.0	53.7	12.9	8.4		
21.	DSC	13.0	12.0	60.0	40.0		Environment
	RSC	12.5	8.3	41.7	37.5		
	VITM	7.9	31.6	42.1	18.4		
	TNSTC	8.0	8.5	52.5	31.0		
	Average	10.4	15.1	49.1	31.7		
22.	DSC	16.2	10.0	48.4	0.0	5.4	Companion
	RSC	16.3	10.2	67.4	0.0	6.1	
	VITM	8.9	26.7	35.6	0.0	28.8	
	TNSTC	13.0	27.0	42.0	0.0	15.0	
	Average	13.9	18.7	53.5	-	13.9	
23.	DSC	46.2	7.7	25.6	20.5	-	Background
	RSC	43.9	10.4	10.4	33.3	2.0	
	VITM	46.0	2.7	8.1	37.8	5.4	
	TNSTC	34.0	12.0	13.0	41.0	-	
	Average	42.5	8.2	14.3	33.1	1.9	

LEARNING STYLES

Q. No.	Name of Science Centre	Category Columns					Study Subject
		a	b	c	d	e	
24.	DSC	53.8	5.2	28.2	12.8		Visiting Time Preference
	RSC	26.0	12.0	32.0	30.0		
	VITM	56.4	2.6	12.8	28.2		
	TNSTC	50.5	15.5	13.0	21.0		
	Average	46.7	8.8	21.5	23.0		
25.	DSC	86.8	13.2	-	-		Motivation
	RSC	79.6	16.3	4.1	-		
	VITM	85.3	11.8	2.9	-		
	TNSTC	59.0	10.0	24.0	-		
	Average	77.7	12.8	7.8	1.7		
26.	DSC	51.5	42.4	6.1			Structure of exhibits
	RSC	75.0	11.4	13.6			
	VITM	73.5	11.8	14.7			
	TNSTC	69.0	19.0	12.0			
	Average	67.2	21.2	11.6			
27.	DSC	47.4	36.9	13.1	2.6		Operation of exhibits
	RSC	51.9	38.5	5.8	3.8		
	VITM	36.8	52.6	8.0	2.6		
	TNSTC	66.0	24.0	8.0	2.0		
	Average	50.6	38.0	8.7	2.7		
28.	DSC	36.8	18.5	44.7	-		Assessment of Science Centre
	RSC	48.0	4.0	48.0	-		
	VITM	55.6	19.4	22.2	2.8		
	TNSTC	52.5	8.0	37.5	2		
	Average	48.2	12.5	38.1	1.2		

DSC: District Science Centre, Tirunelveli, Tamil Nadu.
RSC: Regional Science Centre, Tirupathi, Andhra Pradesh.
VITM: Visvesvaraya Industrial & Technological Museum, Bangalore, Karnataka.
TNSTC: TamilNadu Science & Technology Centre, Chennai-25, Tamil Nadu.

TABLE G1

SATISFACTION FUNCTIONS IN VISITOR'S LEARNING TREND
FOR ALL FOUR SCIENCE CENTRES

	Name of Functions	Average Number of Persons Satisfied in all Science Centres	Cumulative Number of Persons	Cumulative %
A)	Self Motivation	145	145	13
B)	Modular Structure	134	279	24
C)	Regular Concentration	108	387	34
D)	Friends as Companion	107	494	43
E)	Relaxed Environment	105	599	52
F)	Popularisation of S&T	103	702	61
G)	Self Operation	101	803	70
H)	Good Assessment	96	899	78
I)	Morning Time Preference	93	992	86
J)	Light Background Music	85	1077	93
K)	Reading & Writing	78	1155	100

TABLE G2

DISSATISFACTION FUNCTIONS OF VISITORS TOWARDS
SCIENCE CENTRES - VITM, BANGALORE

	Name of Functions	Number of persons Dissatisfied	Cum. persons	Cum %
A)	Advertisement	200	200	49
B)	Recreation	55	255	62
C)	Civic Amenities	38	293	72
D)	New Concept	36	329	80
E)	Exposition of Exhibits	32	361	88
F)	Science Park	21	382	93
G)	Entry Fees	16	398	97
H)	Visiting Timings	6	404	99
I)	Curiosity	5	409	100

TABLE G3

DISSATISFACTION FUNCTIONS OF VISITORS TOWARDS
DISTRICT SCIENCE CENTRE, TIRUNELVELI

	Name of Functions	Number of persons Dissatisfied	Cum. persons	Cum %
A)	Advertisement	174	174	38
B)	Recreation	91	265	57
C)	Exposition of Exhibits	47	312	68
D)	Civic Amenities	45	357	77
E)	New Concepts	42	399	86
F)	Visitors Timing	30	429	93
G)	Entry Fees	16	445	99
H)	Science Park	11	456	99
I)	Curiosity	6	462	100

TABLE G4

**DISSATISFACTION FUNCTIONS OF VISITORS TOWARDS
REGIONAL SCIENCE CENTRE, TIRUPATHI**

	Name of Functions	Number of persons Dissatisfied	Cum. persons	Cum %
A)	Advertisement	83	83	23
B)	Recreation	64	147	40
C)	Civic Amenities	53	200	54
D)	Entry Fees	45	245	66
E)	New Concepts	38	283	77
F)	Visitors Timings	37	320	87
G)	Exposition of Exhibits	32	352	95
H)	Science Parks	13	365	99
I)	Curiosity	4	369	100

TABLE G5

**DISSATISFACTION FUNCTIONS TOWARDS SCIENCE CENTRE
TNSTC, CHENNAI**

	Name of Functions	Number of persons Dissatisfied	Cum. persons	Cum %
A)	Advertisement	180	180	39
B)	Recreation	66	246	53
C)	Exposition of exhibits	44	290	63
D)	Science Park	42	332	72
E)	New Concepts	40	372	81
F)	Civic amenities	32	404	87
G)	Entry Fees	26	430	93
H)	Curiosity	22	452	98
I)	Visiting Timings	10	462	100

PART C
VISITOR'S EXPRESSIONS ON SCIENCE EXHIBITS (VITM, BANGALORE)
IN PERCENTAGE

Table :C 1

Sl. No.	Name of the gallery	Display Attraction		Ability to express Principles		Understandability		Conclusion
		Y	N	Quoted	Not Quoted	Difficult	Easy	
1.	Heart	83	17	34	66	22	78	<ul style="list-style-type: none"> * 92% of the visitors like the display technique of the galleries. * Knowing principle of exhibit is almost 50-50% level. * 75% of the visitors understands the exhibits. * Fun Science gallery & Electrotechnic exhibits expose the principles to the visitors easily. * Easy understandability in popular science & children's science
2.	Engine hall	96	4	12	88	19	81	
3.	Electro technic	87	13	70	30	27	73	
4.	Fun Science	87	13	67	33	43	57	
5.	Timber, Paper & Metals	100	0	50	50	33	67	
6.	Popular Science & Children Science	100	0	46	54	10	90	
	Average	92	8	47	53	26	74	

54-A

PART C
VISITOR'S EXPRESSIONS ON SCIENCE EXHIBITS (RSC, Tirupathi, A.P.)
IN PERCENTAGE

Table : C 2

Sl. No.	Name of the gallery	Display Attraction		Ability to express Principles		Understandability		Conclusion
		Y	N	Quoted	Not Quoted	Difficult	Easy	
1.	Motion I	93	7	37	63	15	85	* 95% of the visitors like the display technique of the galleries. * Knowing principle of exhibit is almost 50-50% level. * More than 80% of the visitor understands the exhibits.
2.	Motion II	100	0	45	55	14	86	
3.	Children's Science	88	12	38	62	17	83	
4.	Fun Science	100	0	41	59	10	90	
5.	Science Park	96	4	52	48	11	89	
	Average	95	5	43	57	13	87	

PART C
VISITOR'S EXPRESSIONS ON SCIENCE EXHIBITS (DSC, TIRUNELVELI, TAMIL NADU)
IN PERCENTAGE

Table : C 3

Sl. No.	Name of the gallery	Display Attraction		Ability to express Principles		Understandability		Conclusion
		Y	N	Quoted	Not Quoted	Difficult	Easy	
1.	Treasures from Ocean	92	8	38	62	32	68	* 93% of the visitors like the display technique * Knowing principle of the exhibits is almost 50-50% level. * 60-70% of the visitors understands the exhibits. But the understanding difficulty of the visitors in district science Centre is almost 3 times that of National Science Centre and definitely more than Regional Science Centre. (May be due to higher literate zone) in National & Regional Centres)
2.	Ocean Quest	100	0	35	65	56	44	
3.	Popular Science (Ground Floor)	85	15	71	29	38	62	
4.	Popular Science (First Floor)	100	0	18	82	19	81	
5.	Science Park	88	12	50	50	17	83	
	Average	93	7	42	58	32	68	

**DATA ON DEMOGRAPHIC VALUES OF VISITORS FROM
NCSM (IN PERCENTAGE)**

Table : D1

Sl. No.	Name of the Centre	A	S	M	F	≥ G	< G	T		E		Conclusion
								L	O	E	NE	
1.	DSC, Tirunelveli, Tamil Nadu (NCSM)	15	85	62	38	51	49	100	0	18	82	* Bangalore being a cosmopolitan area, other location visitors are more than local; also employed people are more in visitors in Bangalore compared to other centres. * Similarly in Chennai, TN.
2.	RSC, Tirupathi, A.P. (NCSM)	20	80	94	6	38	62	88	12	16	84	
3.	VITM, Bangalore, Karnataka (NCSM)	47	53	90	10	62	38	34	66	64	36	
4.	TNSTC, Chennai, TN	66	34	68	32	76	24	44	56	63	37	

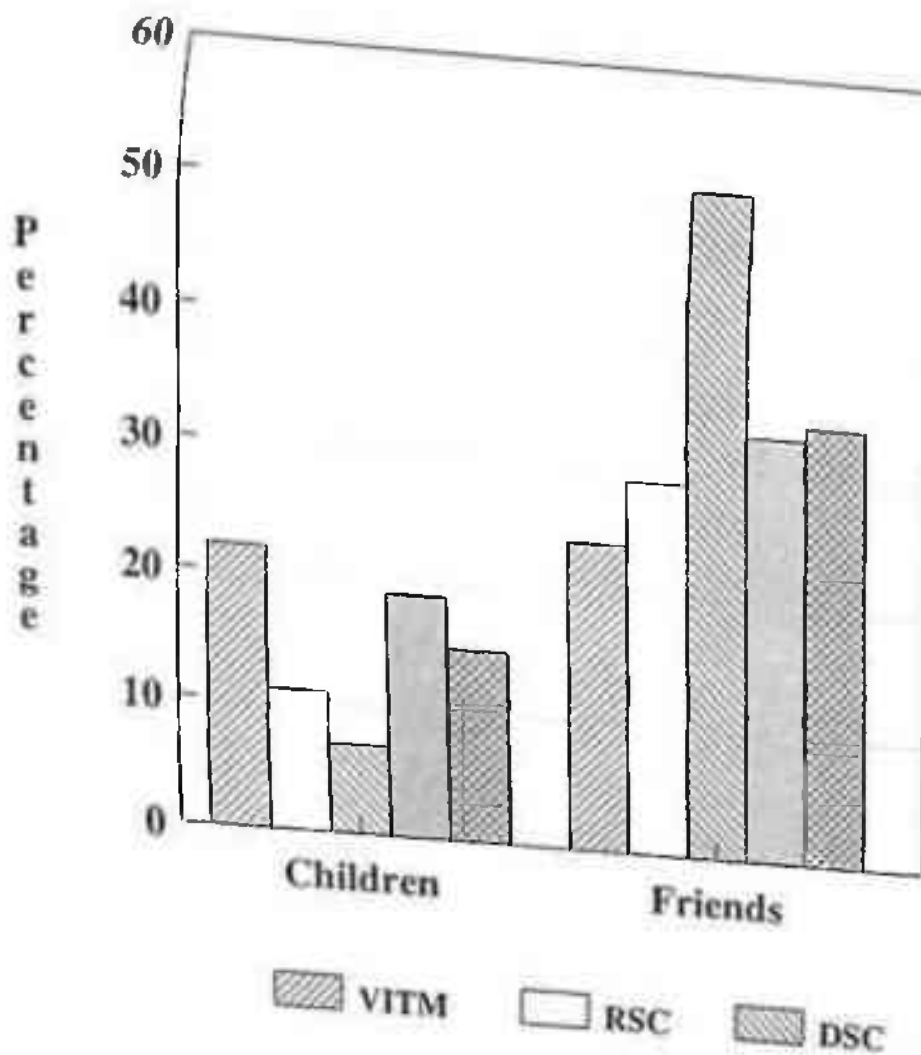
A : Adult S : Students
G : Graduate T : Territory

M : Male
E : Employed

F : Female
L : Local

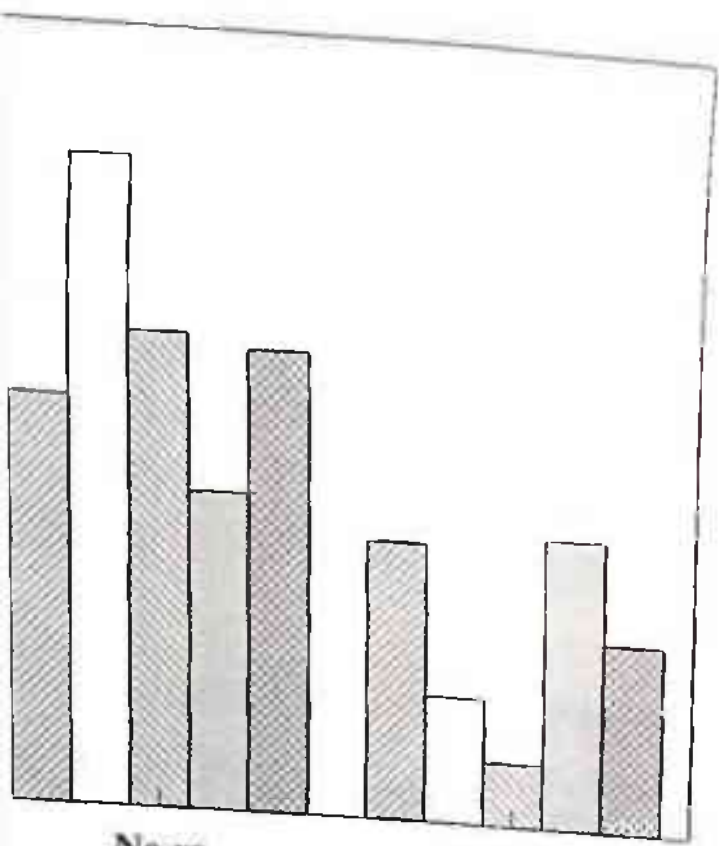
O : Others
NE : Not employed

67-A



General Questionnaire
 "On Science Centre"-
 NCSM & TNSTC, India.

LUENCE



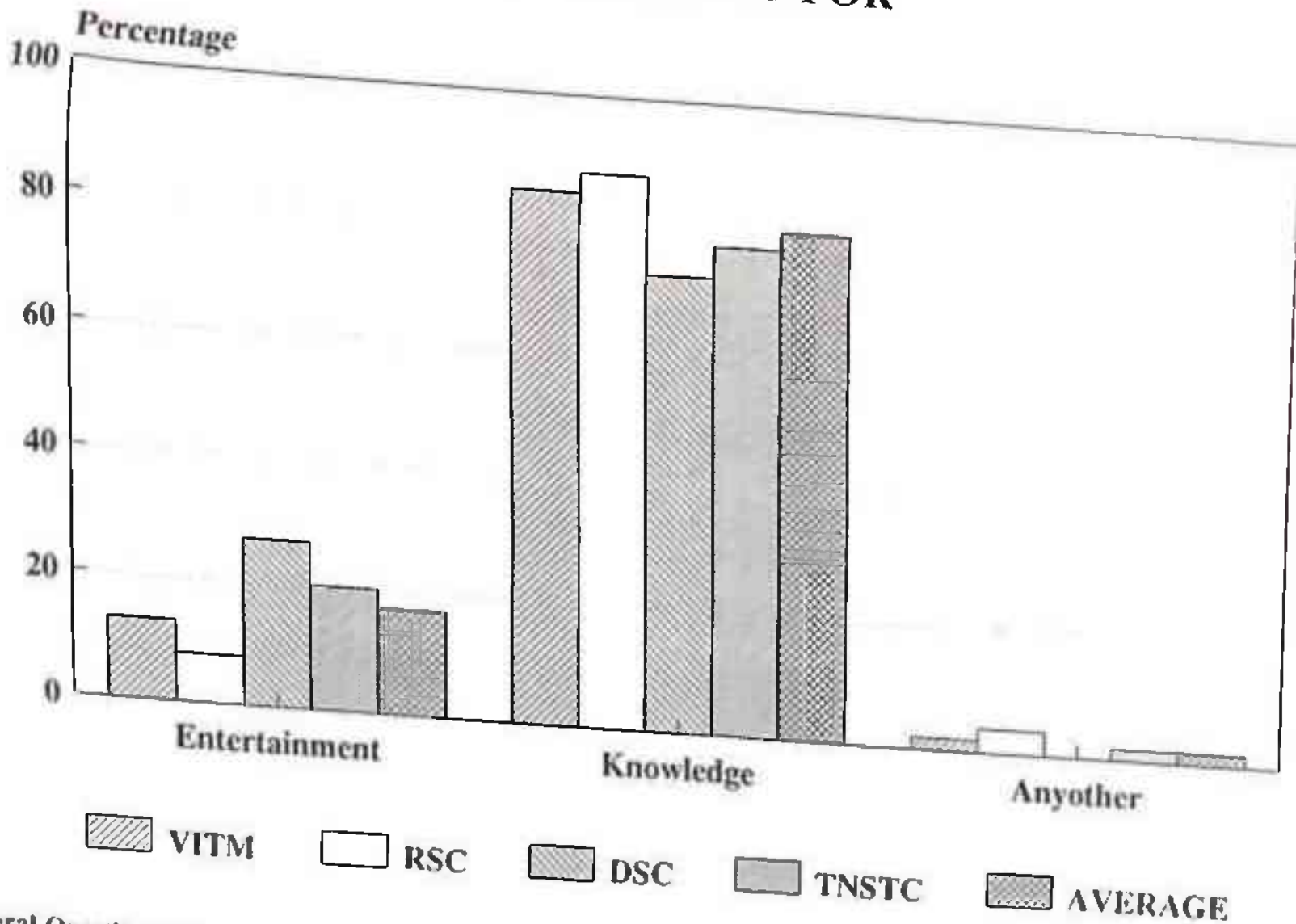
News

Others

TNSC

AVERAGE

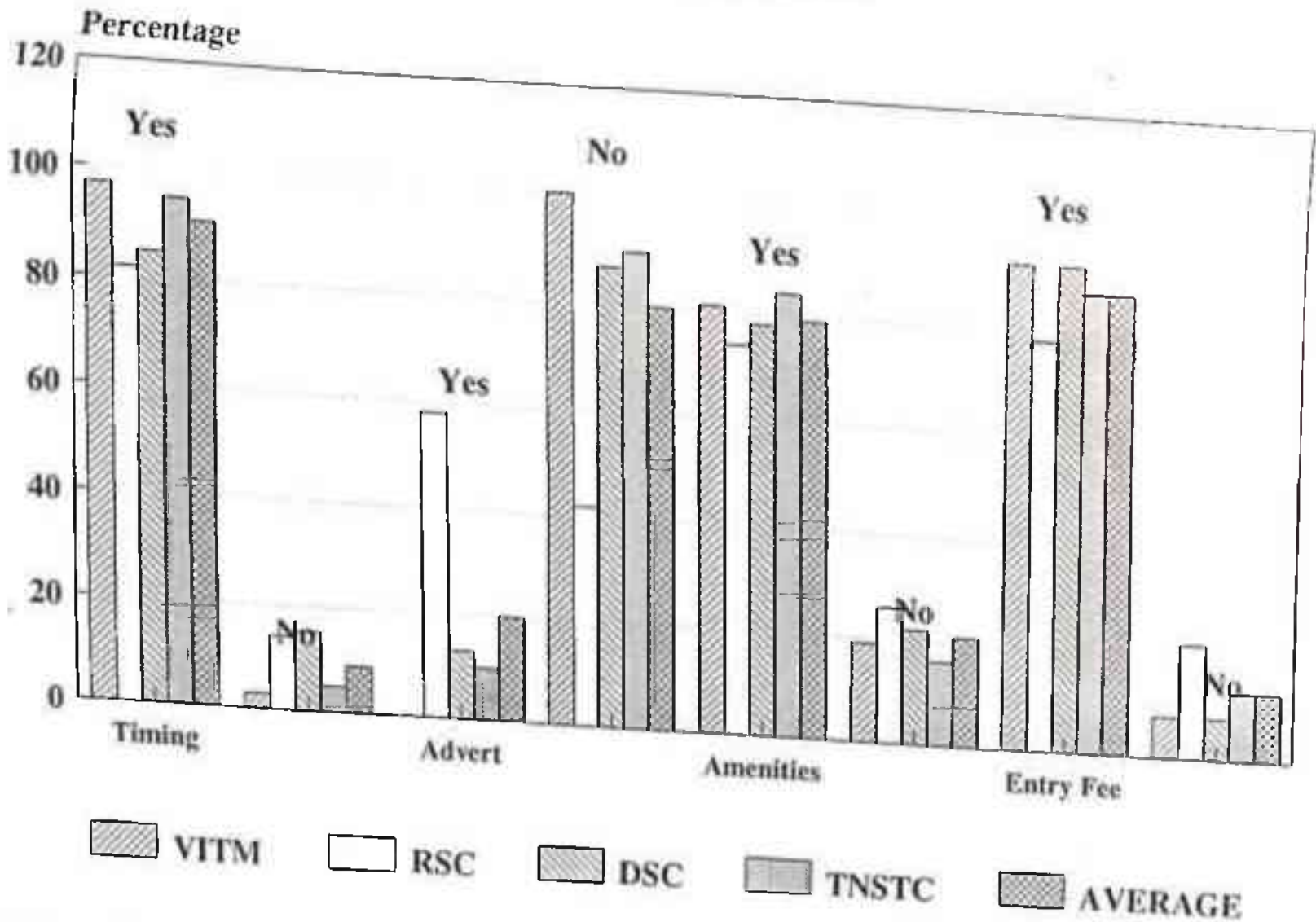
05. SEEKING FOR



V-50

General Questionnaire
"On Science Centre".
NCSM & TNSTC, India.

06. FACILITIES

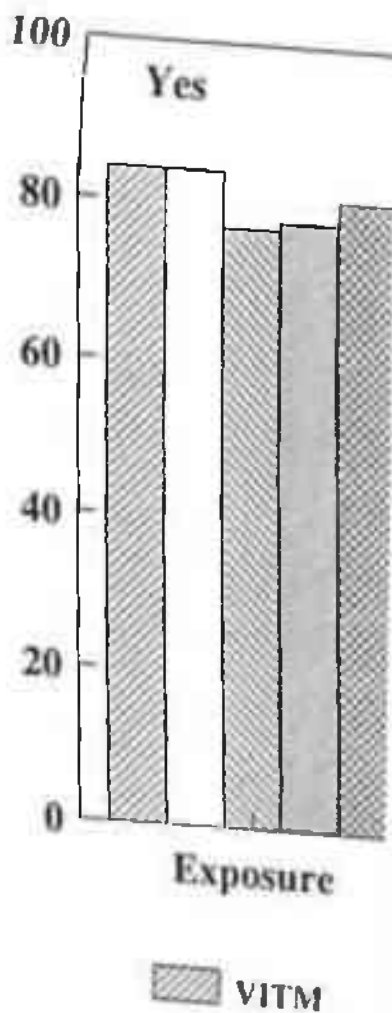


V-51

General Questionnaire
 "On Science Centre".
 NCSM & TNSTC, India

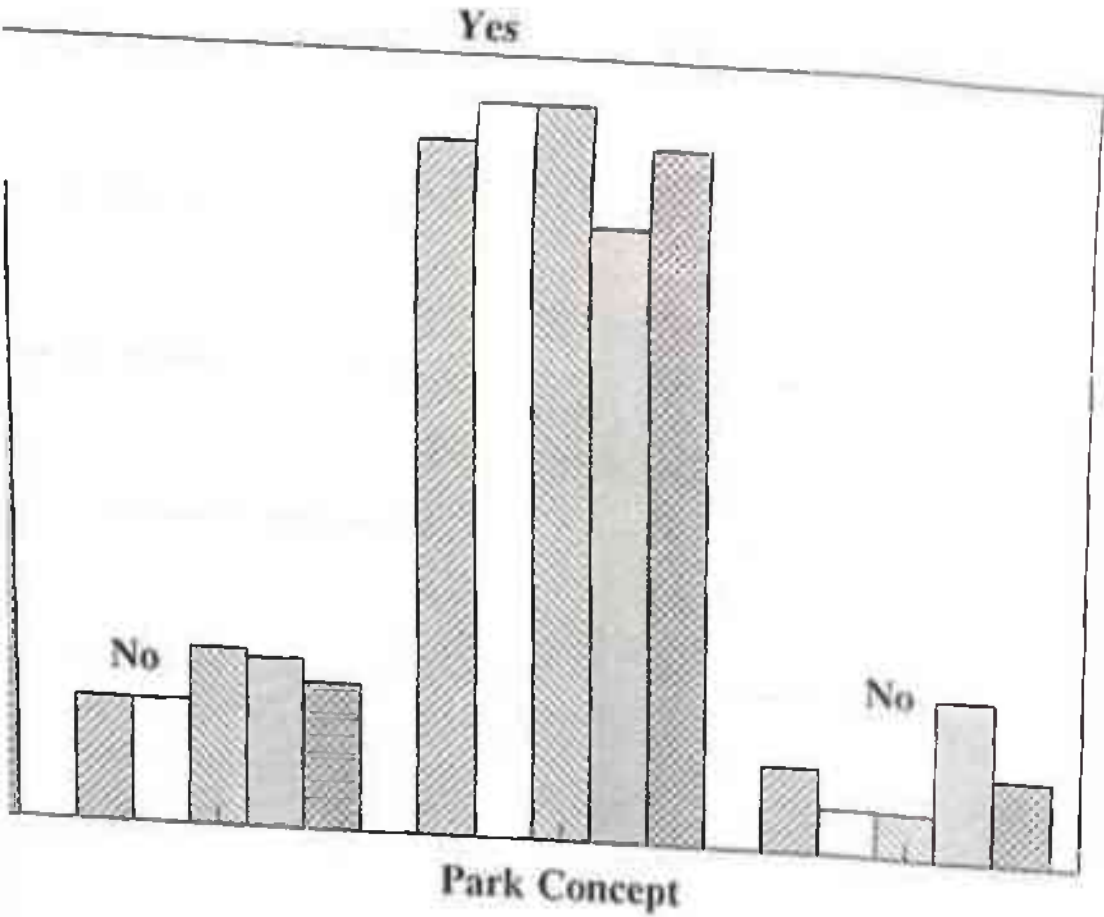
V-52

P e r c e n t a g e



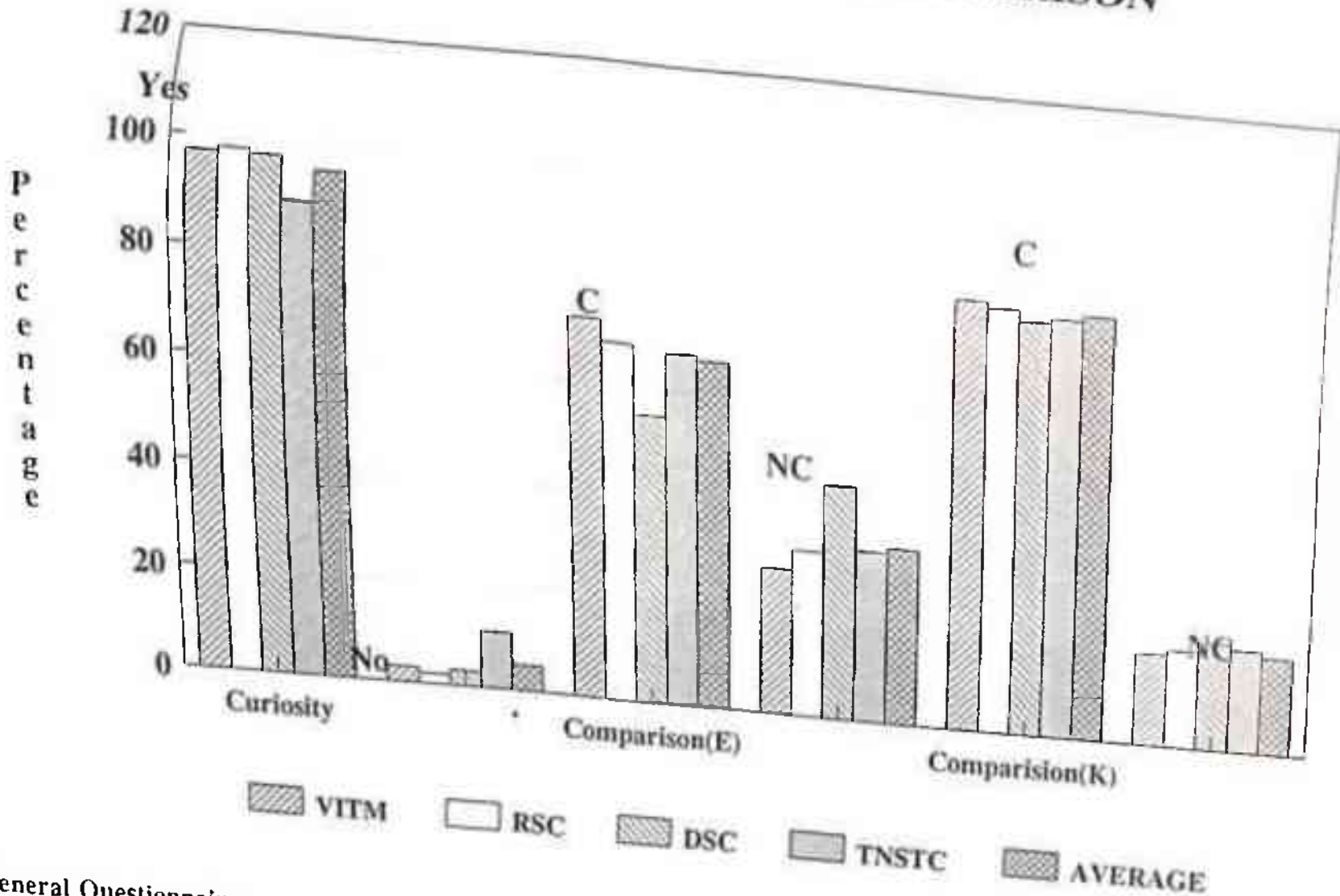
General Questionnaire
"On Science Centre"-
NCSM & TNSTC, India

07 & 09 SATISFACITON



- RSC
- DSC
- TNSTC
- AVERAGE

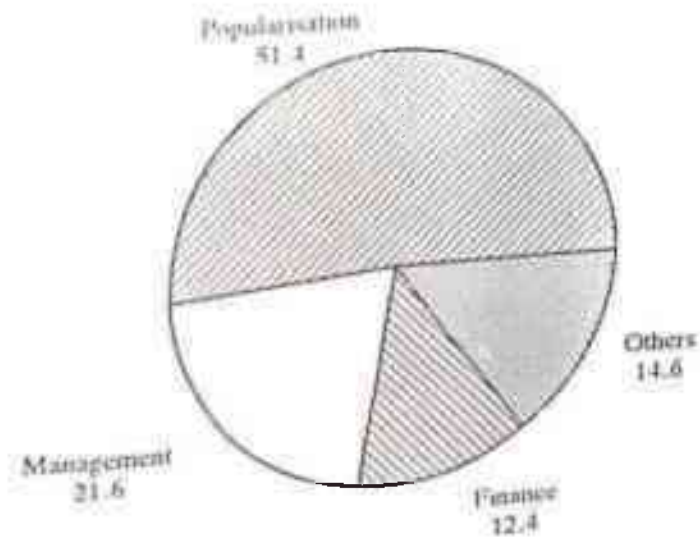
08 CURIOSITY AND COMPARISON



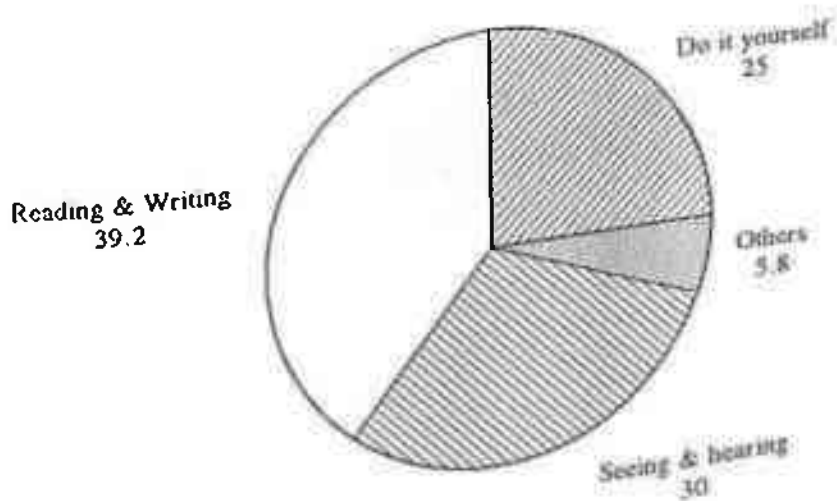
General Questionnaire
 "On Science Centre"
 NCSM & TNSTC, India

V-53

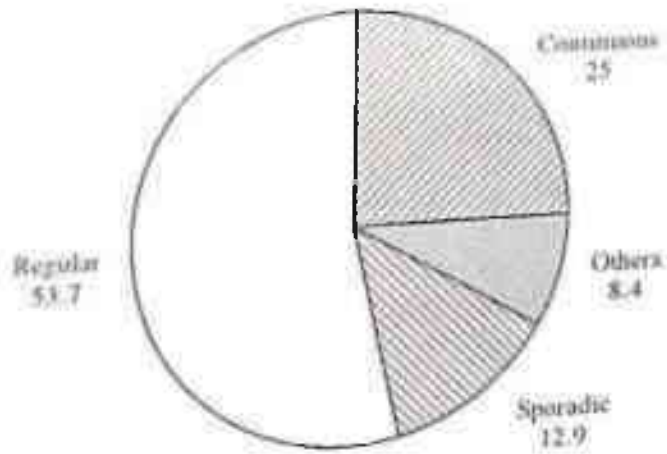
Q.18 Professional Level



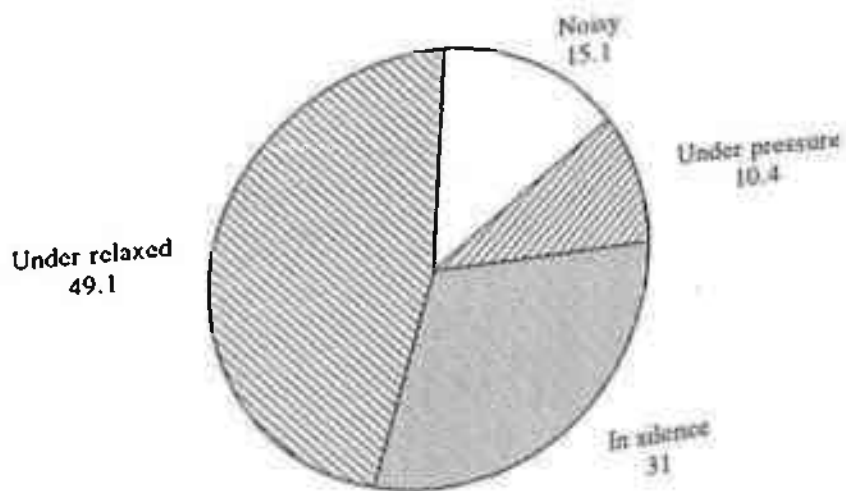
Q.19 Learning Strength



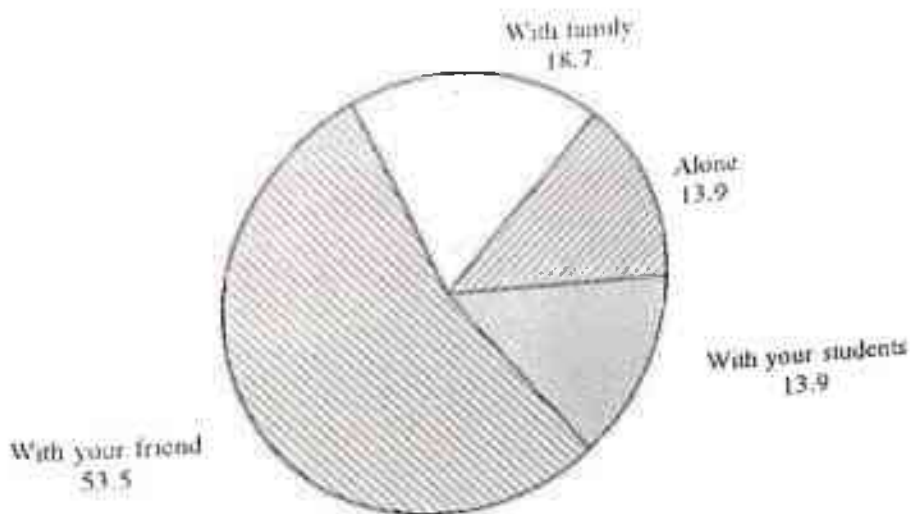
Q.20 Concentration



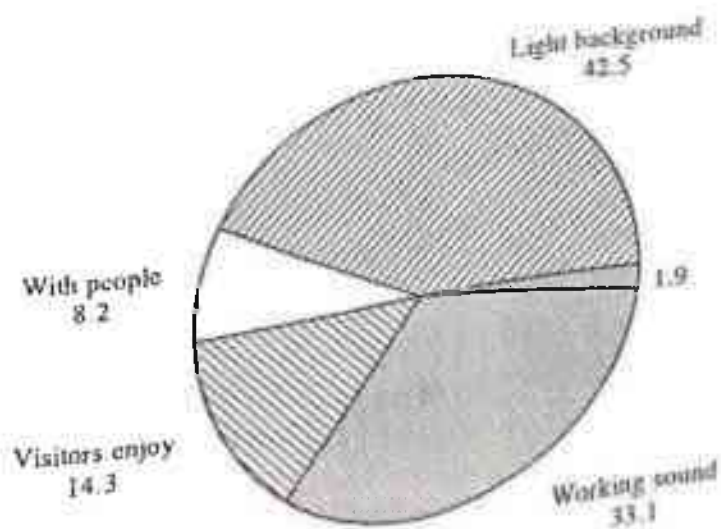
Q.21 Environment



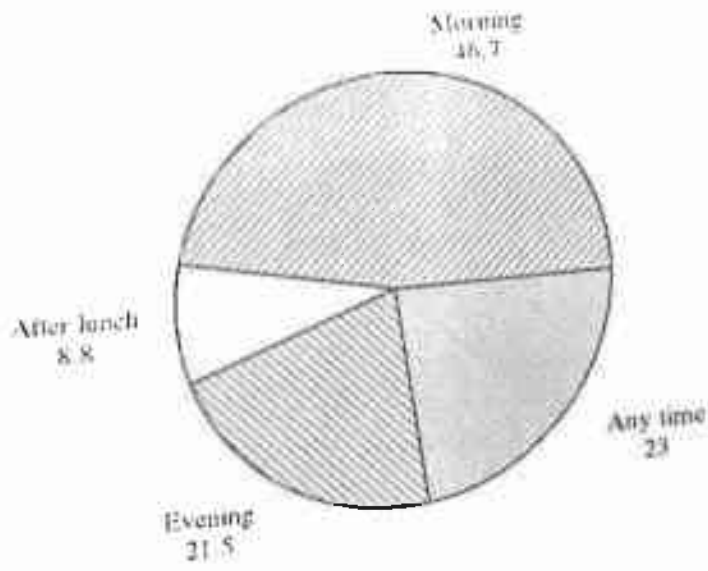
Q.22 Companion



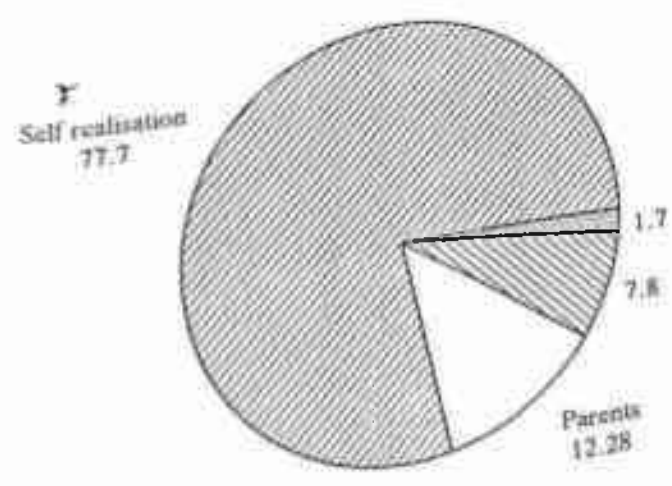
Q.23 Background



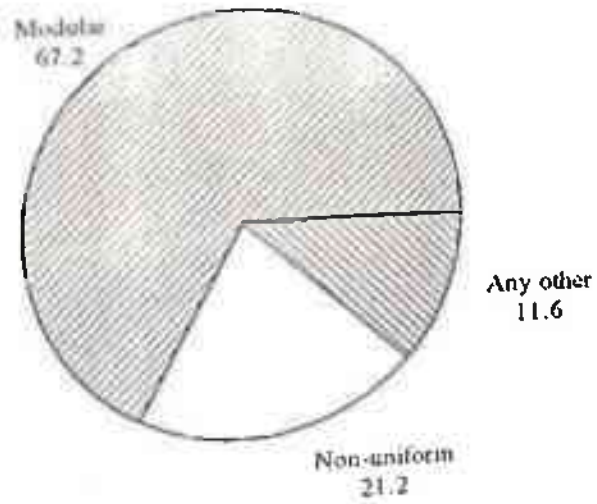
Q.24 Visting Time



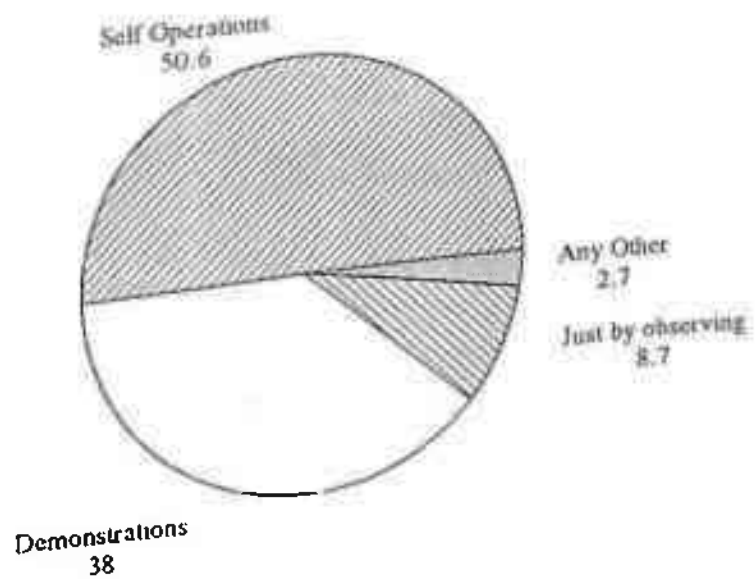
Q.25 Motivation



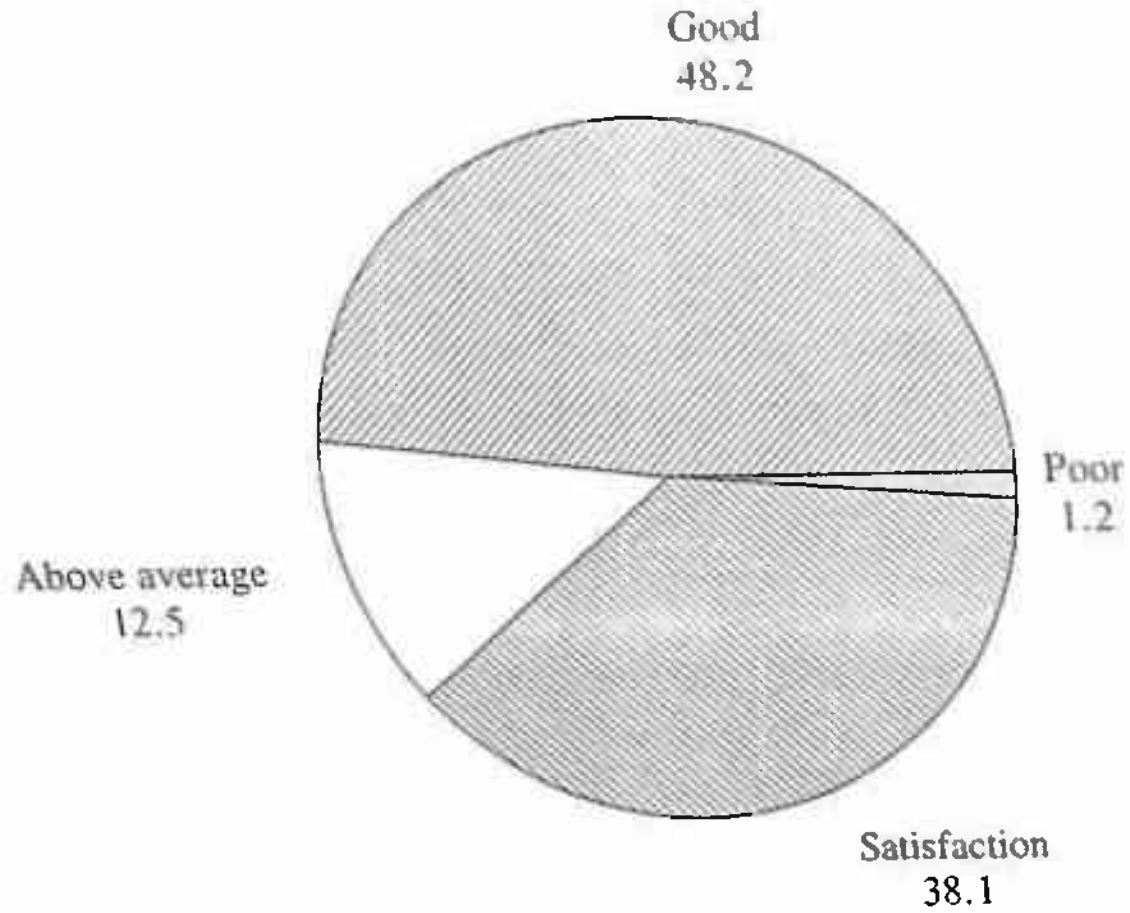
Q.26 Structure of exhibits



Q.27 Operation of exhibits

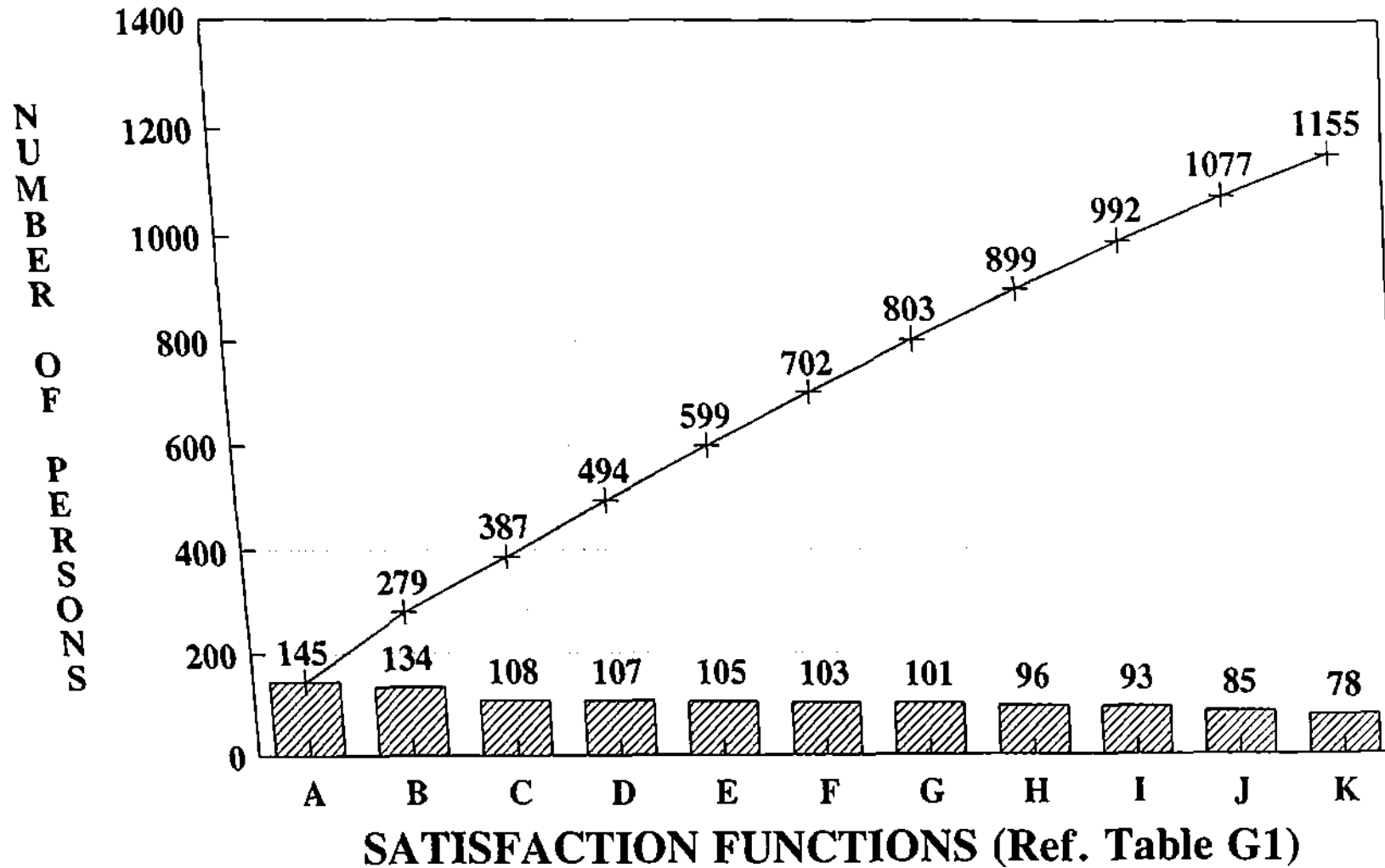


Q.28 Assessment of Science Centre

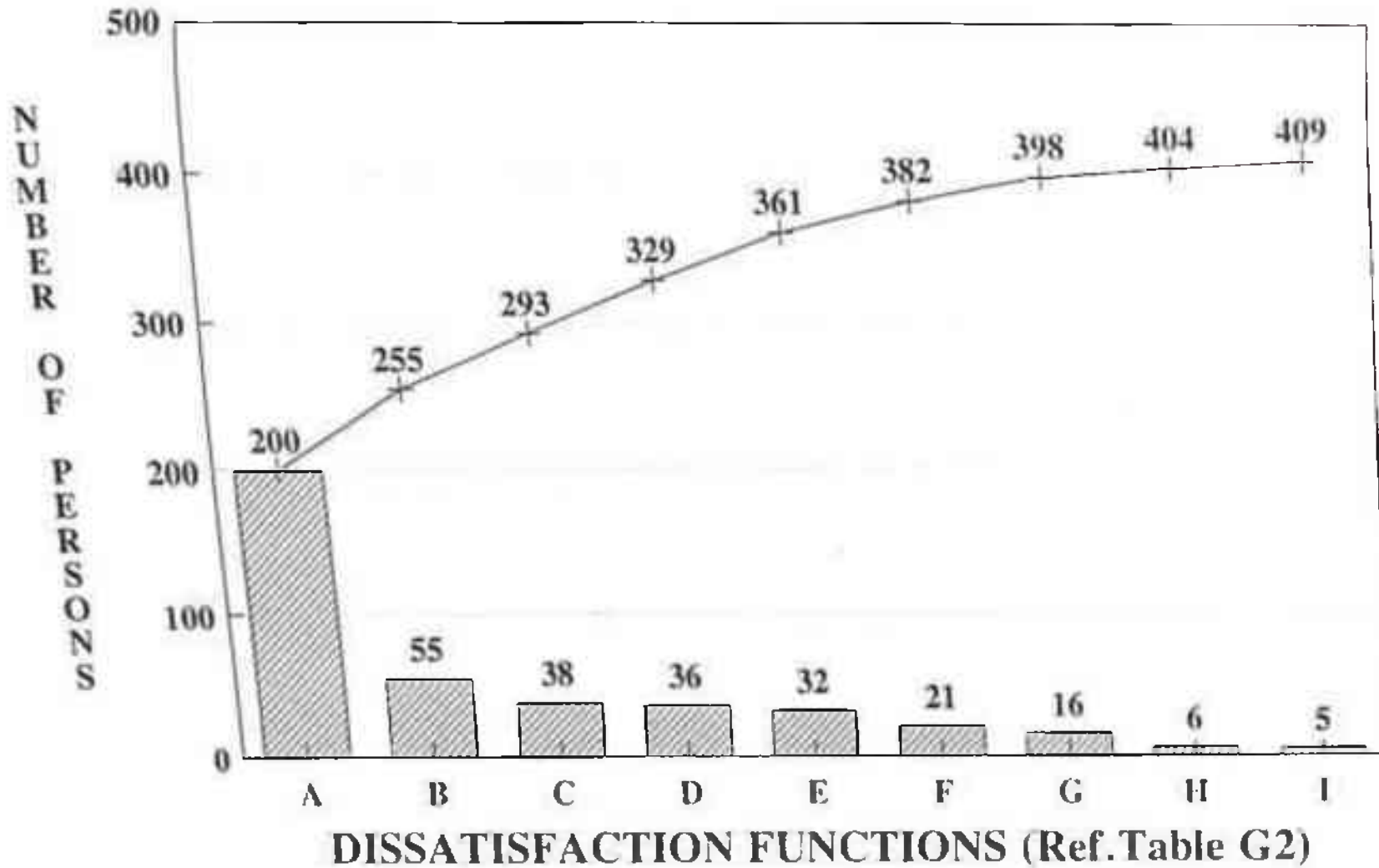


G1 - Satisfaction Functions (Learning) for four Science Centres

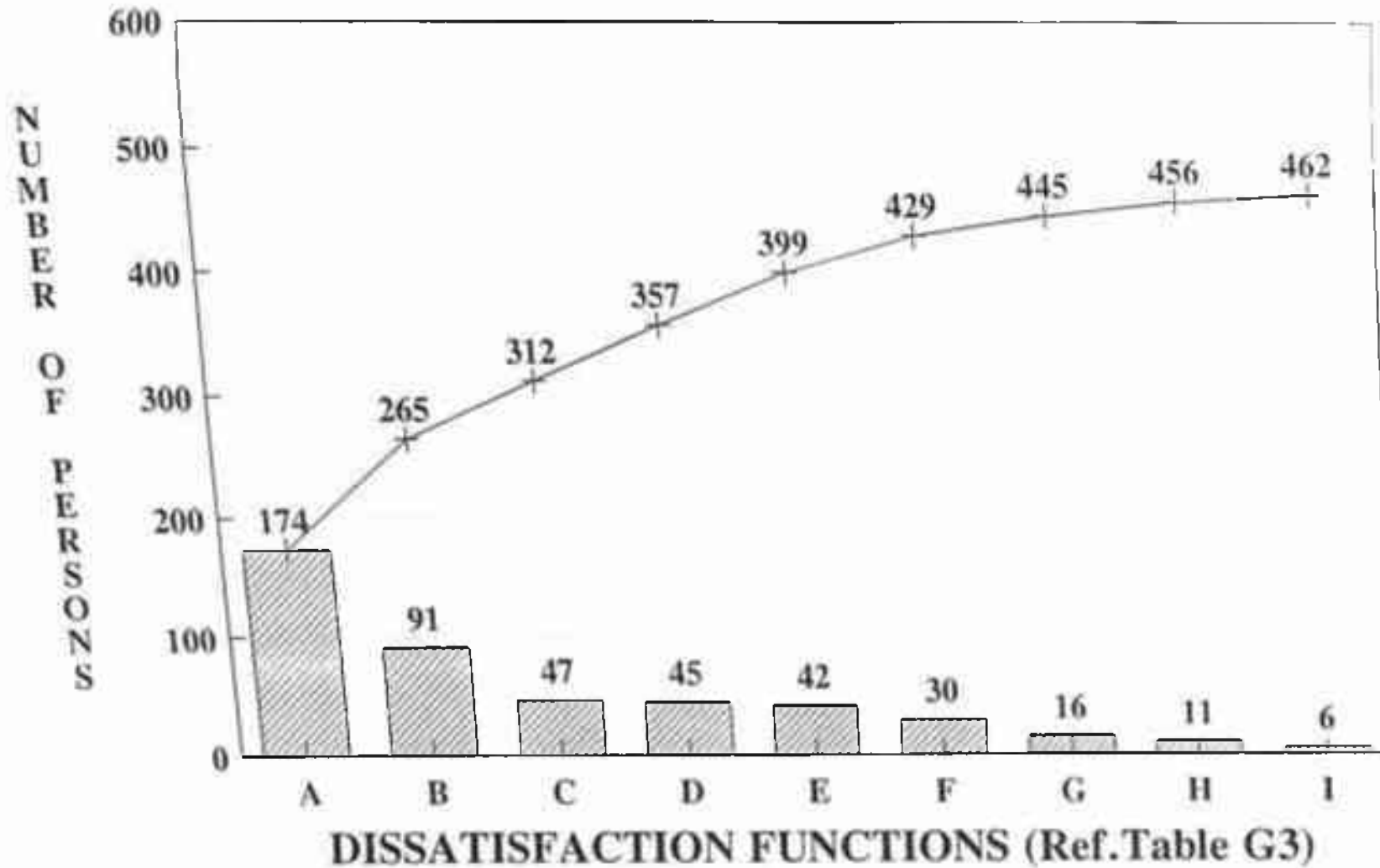
V-60



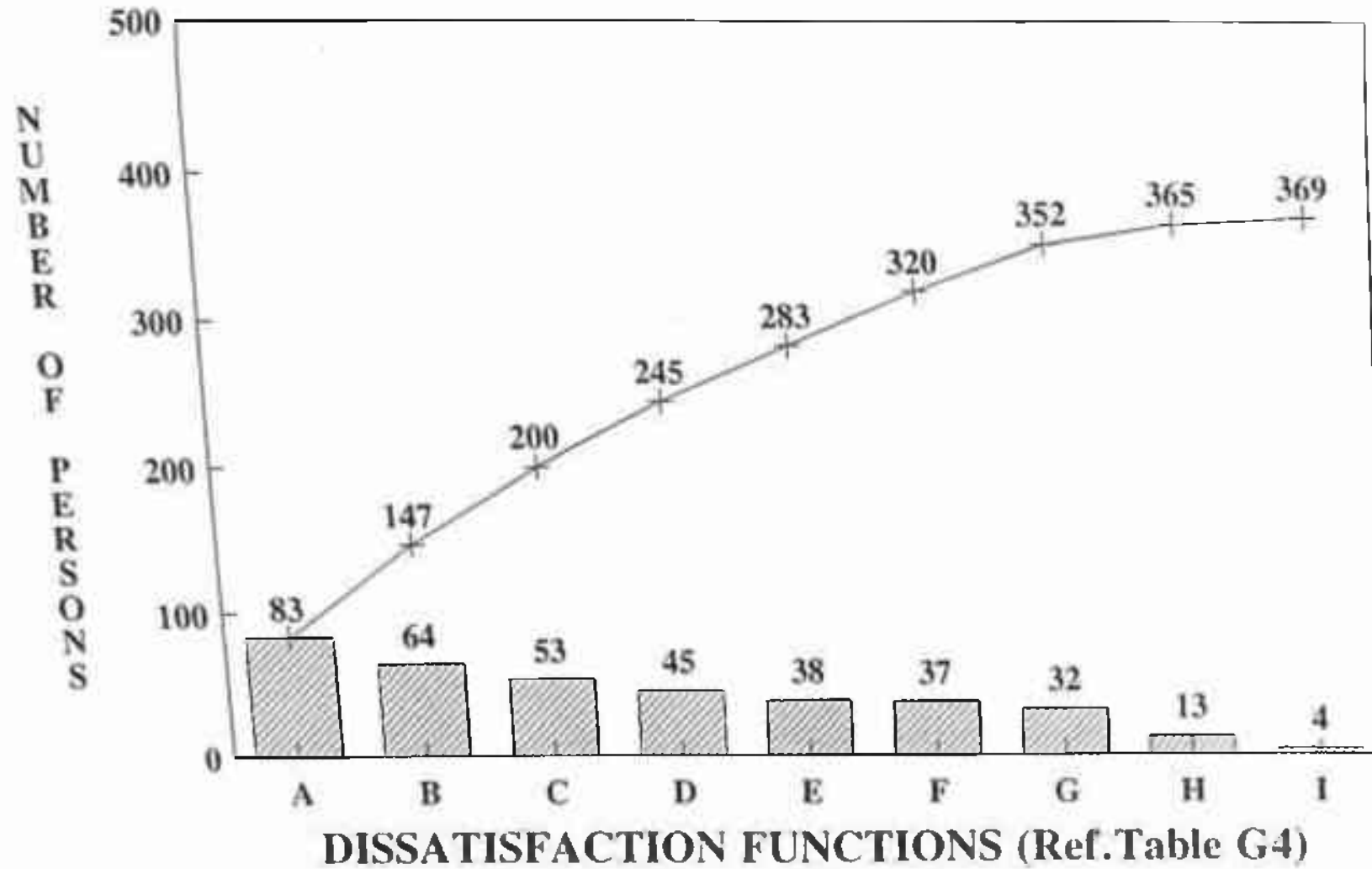
G2 - Dissatisfaction Functions (Science Centres)



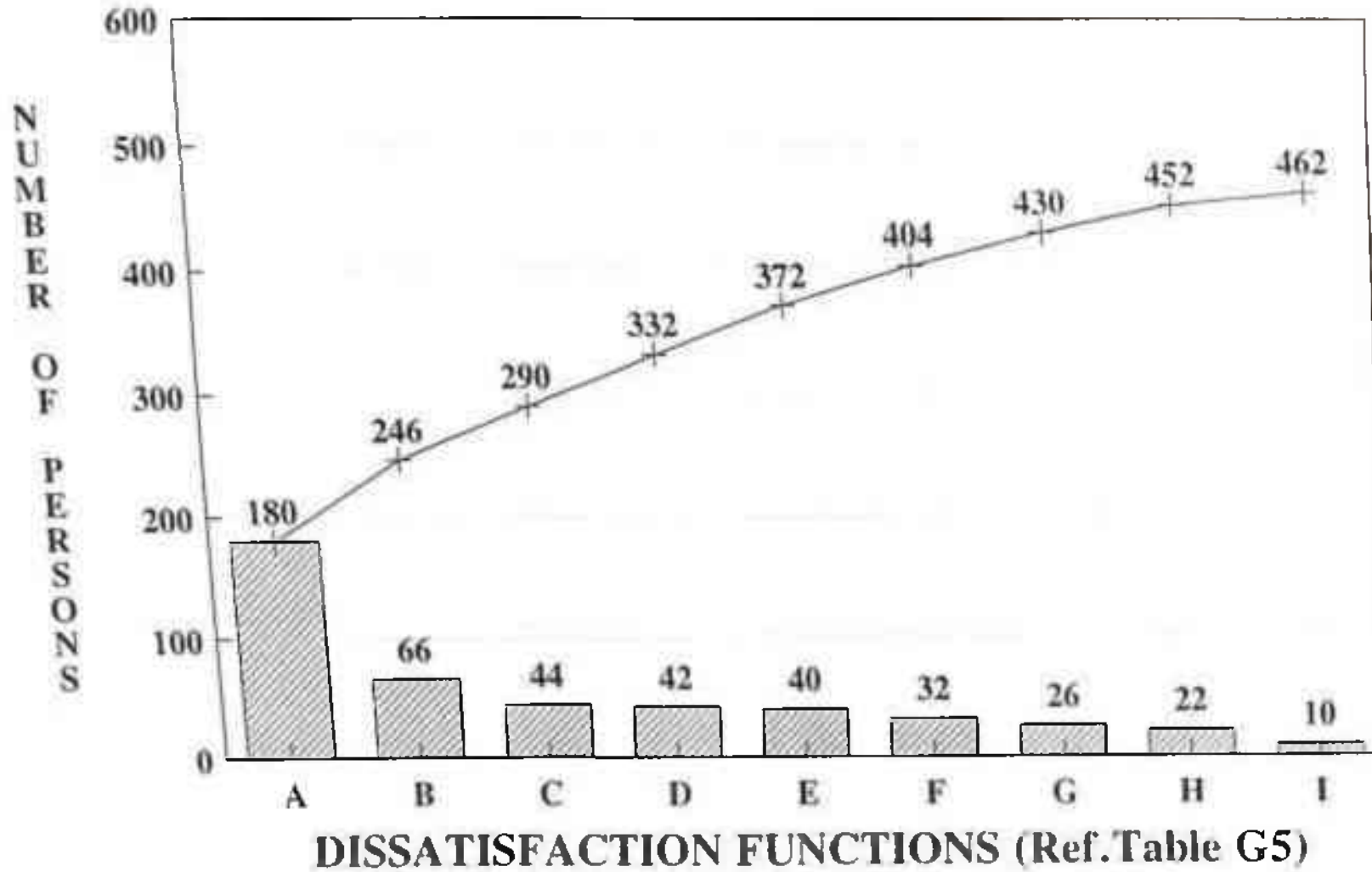
G3 - Dissatisfaction Functions (DSC, Tirunelveli)



G4 - Dissatisfaction Functions (RSC, Tirupathi)



G5 - Dissatisfaction Functions (TNSTC, Chennai)



CHAPTER - VI

VI. EXPECTED OUTCOMES

The study made on the role of S&T centres reveals the following outcomes.

1. Societal expectations of the renowned Scientists & Technocrats have been fulfilled by the role of S & T centres.
2. A change in the society towards the achievement of better educated and cultured groups has been activated by the development of S&T centres.
3. Educating the masses of society about S & T developments for peaceful and useful purposes has been given as a higher priority task for the S&T centres.
4. The society wishes that the concept of S & T centres should provide another form of informal education centres. (Refer data - Appendix 03 - Pg.149).
5. Society feels that S & T centres have created a place of entertainment environment for learning Science & Technology themes. (Refer data - Appendix 01 - Pg.115 and Table VI, Pg.119).
6. The Science Exhibits have to be of interactive and educative to the students and general public. (Refer page 141 Table II).
7. Science Centres have been considered as learning centres for the visitors.
8. Science Centres act as carrier of message of S & T to various remote corners of the continent.

9. The aim of the visitors is to seek the knowledge of science rather than entertainment. (Refer Pg.115, Table II)
10. Science Centre's working time can be in the day-time. The visitors prefer to visit Science Centres during holidays and summer vacations. (Refer Pg.115, Table II)
11. The facilities of the Science Centres are mostly liked by maximum visitors.
12. A compromise has to be made between the advertisement and the revenue to the centres.
13. Well - equipped souvenir shops are needed by the visitors. (About 58% of visitors prefer souvenir shops as in Pg.109).
14. Visitors prefer Science Parks in the surrounding area of Science Centres to relax and learn. (Refer Table VI, Pg.119).
15. It is also stressed that many more Science Centres have to be established in future with the modern subjects on S & T so that many children, students, teachers and public will be benefitted with little cost, more knowledge in a short span of life time. (E&C gallery is preferred by maximum visitors - as in Table V, Pg.118).
16. Visitors prefer more exhibits in action instead of static models from the data received on Science exhibits. The following are some of their reactions on exhibits. (Refer Appendix No.02 for data).

- a. Visitors are keen on watching motion and selection of items in an exhibit.
- b. Visitors become opportunist in utilising the big models which they would find difficult in visiting the real ones.
- c. Most of the visitors could not understand the S&T concepts.
- d. Visitors are attracted by the lighted and animated portion of the exhibit.
- e. Visitors are equating and giving equal importance to acceptable things to society and also like most acceptable ones to common man.
- f. Visitors expect that the exhibit have to be exhibited to their ability of understanding.
- g. Visitors prefer a lot of change in the exhibits than the same types.
- h. Visitors sometimes feel exhaustive of the exhibits.
- i. 50% of the visitors have no patience to look for the label in the exhibits. It indicates that an attraction is needed in displaying the labels. More exhaustive labels are not liked by visitors.
- j. 20% of visitors have lack of knowledge in the Science & Technology.
- k. About 70.5% of visitors watch the exhibits with effects.

17. Study on learning styles of visitors reveal the following. (Refer Appendix-03)

- a. Visitors occupy maximum style of popularisation activities in their field as profession than administration and finance.
- b. The data regarding learning strength proves the Chines proverb voting max i.e. 36% to "Do it yourself".
- c. Regular concentration prevails among the visitors.
- d. Relaxed environment is needed by the visitors.
- e. Friends are the best companions for the visitors while learning the exhibits.
- f. While learning in Science Centres, they need a background of light music.

- e. A quite sound level is expected by the visitors instead of wavery sounds.
 - f. Visitors prefer morning time for learning in Science Centres.
 - g. Self - motivation is hidden in the visitor for learning purpose. No teaching assistance is required for the visitors.
 - h. Visitors want to adopt experiencing methodology for learning in Science Centres.
 - i. Modular or uniform structures of exhibits are expected by the visitors.
 - j. Self - explanatory type of exhibits are more expected by the visitors than demonstration, static and other types.
 - k. Visitors rate the Science Centres as good and acceptable.
- 18) Relevant topics such as Materials Science, Computer Science play key - roles in motivating the visitors to visit Science Centres and learn the challenging S & T fields.
19. Also the modern techniques such as multimedia touch screen computer driven displays can be located inside the galleries for the benefit of the visitors to reflect their liking topics.

Thus the work carried out in the analysis of this thesis work on Science Centres reveals the above outcomes which can be measurably incorporated by the managers of the Science Centres depending upon by their nature of countries and population.

SUMMARY

Science and Technology centres encourage the students in learning science through the interactive type of exhibits thereby bridging the gap between the facilities that could be made available in every school and what is needed to be learnt by the students.

Hence role of Science Centres is to cater to train the teachers of the schools to equip themselves with the necessary ability of making teaching aids and interactive exhibits. To implement the "NATIONAL EDUCATION POLICY OF 1986 OF THE GOVERNMENT OF INDIA" with reference to science education which lays emphasis on cultivating the spirit of inquiry and a scientific temper in students, it is essential to train the science and mathematics teachers in modern methods of science teaching. The Science Centre plays a very important role to solve the above problem. The study made in this thesis may provide all the infrastructure facilities for the students and teachers to gain maximum benefits.

Science Centres not only supplement the school education but also complement the school science programmes. Activities of the halls of sciences lay emphasis on first hand observation by the students and direct experience in science and mathematics besides the school curriculum.

Also it is inferred that the developing countries need to develop science to stop misuse of science. The types of awareness ranging from the understanding, mastering and the purposefulness of science for peaceful activities have to be born in mind by the citizens of the country while analysing the science for society. An effective interface has to be abridged between science and society. This can be achieved only by creating the infrastructure such as modern concept of Science Centres where the

society will be brought nearer to the uses of science, by means of interactive exhibits on the various fields of S & T.

The Science Centres have to be of learning centres in a non-formal way by having a clean quite healthy environment having the attributes mentioned in this thesis, which are also expected by the visitors. Visitors to Science Centres are the prestigious customers for the Science Centres. The customer's satisfaction is the role requirement to be achieved by the authorised Science Centres.

Hence this study has opened our eyes to look into the above attributes and innovative concepts for the future Science Centres.

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1. *Utility of Science Centres* : R. Madhavan, Communicated to *Current Science*, July, 1987.
2. *Effect of Science Centres over India* : R. Madhavan, Communicated to *International Council of Museums (ICOM)*, France, March, 1997.
3. *Visitor's Reaction on S&T Exhibits of Science Centres* : R. Madhavan, Communicated to "*Iranian Journal of Science and Technology*" Iran, August, 1997.
4. *Expected learning styles of visitors in a Science Centre of a developing country*: R. Madhavan, Communicated to *Journal of Higher Education*, Ohio, August, 1997.
5. *New conceptual design of a science gallery for a modern Science Centre* : R. Madhavan, Communicated to the *Institution of Electronics & Telecommunication Engineers (IETE)*, New Delhi, August, 1997.
6. *A multimedia design for a science gallery - Ceramics & Glass* : R. Madhavan, Communicated to "*Museum International*", Paris, August 1997.
7. *Structural elements for a modern Computer science gallery* : R. Madhavan, Communicated to "*Everyman's Science*", *Indian Science Congress Association*, Calcutta, August, 1997.
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N.B. The synopsis for the above publications were enclosed in Appendix No. 07.

Appendix No. 01

On

"Science Centres"

QUESTIONNAIRE - I (On Science Centres)

- Note:
1. Kindly strike out the answer which is not applicable.
 2. Please be brief in your comments/ remarks.

Er. R. Madhavan, Joint Director (Electronics) of this Centre.

Kindly fill in the following questionnaire and submit it to

01. Date :
02. (a) Name :
(b) Age :
(c) Sex : Male/Female
(d) Occupation :
(e) Qualification :
03. Where do you come from
Madras
Tamilnadu
Other. Please Specify -----
04. What influenced you to visit the Science Museum and Planetarium.
(a) Your Children (b) Friends (c) News items
(d) Any others.
05. Did you come here seeking
(a) Entertainment (b) Knowledge (c) Any others -----
06. (a) Which months of the year do you feel are most suitable to visit this Science Centre?
(b) Please give reasons, if any, for choosing the above months for the visit to the Science Centre.

07. (a) Are the current visiting timings for Science Centre and Planetarium convenient for you?
Yes / No.
- (b) If your answer is "No", Please Specify the convenient timings for you to visit the Centre including Planetarium.
08. Do you agree that the vehicle parking rates are reasonable?
Yes / No.
09. Do you feel that the Canteen facilities are adequate?
Yes/ No.
10. (a) Is the Souvenir shop upto your expectation?
Yes / No.
- (b) If not upto your satisfaction, What further items may be added?
11. If you have seen hoardings (Advertisement Boards) of our Science Centre, Please Specify the locations.
12. Do you find the Civil amenities (drinking water, toilet) are adequate in the Campus?
Yes / No.
13. (a) Are you aware that the Planetarium programmes are periodically Changed?
Yes / No.
- (b) If yes, are you visiting the Planetarium often?
Yes / No.
14. Are the entry fees for the Science Centre and the Planetarium reasonable?
Yes / No.
15. (a) Do You feel satisfied with the programme you have witnessed?
Yes / No.
- (b) If "No" suggest your views to improve the programme.
16. (a) Do you feel satisfied with the exposition of exhibits?
Yes / No.
- (b) If "No" offer your remarks for its improvement.

17. (a) How many Halls of Science of this Museum have you covered, during your present visit? Please mark the Halls with () sign wherever applicable.

Periyar
Energy
Transport
Electronics & Communication
Physical Science.

- (b) Which of the Halls of Science you like most? Highlight Your observation.

18. Do you consider that this Science Centre will inculcate in the Children, curiosity in Science and improve their knowledge in Science and Technology?

Yes /No.

19. How do you Compare this Science Centre to other visiting Places for

(a) Recreation : Comparable/Not Comparable

(b) Learning new concepts: Comparable/Not Comparable

20. Do you agree with the Concept of the outdoor display of exhibits at the Science park?

Yes / No.

21. If you have any new idea or methodology which you wish this Centre should incorporate, Please mention here.

22. Any other suggestions and constructive criticism, you wish to bring to our attention.

(Vistor's Signature)

To

ER.R. MADHAVAN
Joint Director (Electronics)
Tamilnadu Science and Technology Centres
Madras - 600 025.

CONCLUSION

Reason of different halls of Science
Ideas from visitors

Results:

It is inferred from the data that the relatives and friends have
From
influenced the people to visit the Science Centres. It is understood that a link has to be established by the
the popularization of
the Science Centres in general. For
the Science Centres need to be Science Centres in general. For
entertaining atmosphere than for

enjoying in an entertaining atmosphere than for
knowledge. But it is vice-versa when they leave the Science
Centre. The visitors have really learnt a little measure of
knowledge of Science if not full. This inculcates in their mind
new information gathered and further kindles their interest to
there by their surroundings are benefited.

Demographic Values

the type of visitors selected for our
data elements of the demographic value of the
five categories such as Adults, Students,
employment. The percentages of the
e 1. The values are also
no. 04.



The type of Questionnaire to be circulated to visitors has the following themes.

1. Demographical Values
2. Influence to visit Science Centres
3. Timing Factors
4. Facilities
5. Planetarium Show Programmes
6. Indoor/Outdoor Exhibition
7. Comparison of different halls of Science
8. New ideas from visitors

The Results:

It is inferred from the data that the relatives and friends have mostly influenced the people to visit the Science Centres. From this, it is understood that a link has to be established by the Science Centres with people for enunciating the popularisation of science. Also visitors came to the Science Centre in general for enjoying in an entertaining atmosphere than for searching knowledge. But it is vice-versa when they leave the Science Centre. The visitors have really learnt a little measure of knowledge of Science if not full. This inculcates in their mind the new information gathered and further kindles their interest to a larger extent, there by their surroundings are benefited.

1. Demographic Values

These values indicate the type of visitors selected for our analysis. The major data elements of the demographic value of the visitors consist of five categories such as Adults, Students, Graduates (G), Territory and Employment. The percentages of the above categories are shown in Table 1. The values are also graphically represented in the Histogram no. 04.

Random data collection indicates that the data has been collected for this Questionnaire on Science Centres from maximum number of adults than students. The female representation is half that of the male members. The graduates are in many numbers indicating more literate visitors. About 50% of the visitors selected are from the local Region Madras. Also most of the people surveyed are employed.

Collectively, it can be said that the visitors who gave their views on Science Centres are of employed adult literates. Views expressed by the above set of adult literates are analysed as follows.

2. Factors viewed by visitors.

This indicates the factors viewed by visitors selected for our analysis. The major data elements of the factors consist of four categories such as Influence, Seeking, Present Timings, Preferable Visiting Months. The percentage of the above categories are shown in Table - II. The values are also graphically represented in Histogram No. 05 to 06. Random data collection indicates that visitors to Science Centres are influenced by maximum number of friends than other categories such as Children and News items.

It is also inferred from the data that the aim of the visitors is to seek the knowledge of science rather than entertainment which is of 20% in comparison with 78% for knowledge.

Regarding the likelihood of visiting timings, 95% of the visitors in our sample have preferred the present timings. Hence it is not necessary for the centre to change its timings. The most preferable months for visiting the Science Centre and Planetarium are May, December, November, April, October and January respectively. The preferable seasons by the visitors are Autumn and Summer.

3. Facilities:

The facilities are also important requirements for the visitors. The nature of the facilities taken in our analysis are Vehicle Parking, Canteen, Advertisement, Civic Amenities and Souvenir shops. From the Table - III and Histogram No 07 to 12, 78% of Visitors accepted the present vehicle parking facilities and their rates. 65% of the visitors preferred and liked the canteen facilities. Percentage of visitors who have notified the Advertisement Boards of this centre is only 10%. This shows that much advertisements are needed. But the ratio of the cost of advertising and the revenue by the centre has to be very very less in order to compensate other important expenses. Hence any Science Centre can not spend huge money on Advertisement. Also Indirect Advertisement through the communication of visitors to their friends plays already a major role than the visual Advertisement Boards. Hence a compromise has to be made between the Advertisement expenses and the revenue to the centre.

Generally, 84% of visitors are satisfied with the civic amenities of this Centre. Regarding the Souvenir Shop, 58% of visitors have liked the shop. But the remaining visitors expect that more working toys regarding science and technological aspects have to be added to the present Souvenir Shop.

4. Planetarium and Exhibition :

The main attraction of the Science Centre is with the Planetarium Astronomy Programme shows and the Interactive Science & Technology Exhibition. When the study is conducted for the above two aspects, the characteristics such as Awareness of change in Planetarium shows, Frequent visit to Planetarium, Reasonability of Entry Fees, the measure of satisfaction with the Planetarium Programme and Science Exhibition have been studied with the available sample of visitors (Please refer Table- IV and Histogram No.13 to 12).

69% of the visitors aware that the planetarium programmes have been changing for every two months with the new programmes. Also 44% of the visitors visit the planetarium programmes often. 87% of the visitors are satisfied with the entry fees for Science and Planetarium.

Regarding the satisfaction of the Planetarium programmes and Science Exhibits, 82% of visitors liked the planetarium Programme shows as compared to 78% for science exhibits. This shows that both planetarium shows and science exhibits attract almost equally the visitors towards acquiring the knowledge of science.

5. Halls of Exhibition (Comparision):

This centre as referred earlier, consists of presently 5 Galleries opened to the visitors. They are periyar/ International Dolls Exhibition, Energy, Transport, Electronics & Communication and Physical Science. The Table - V and Histogram No.17 depicts the statistics of visitors who visited all the galleries and who visited only individual set of galleries. Referring the data, it is observed that 70% of visitors have patience and time to visit all halls of exhibition and have aptitude to sharpen their knowledge.

Among the busy Visitors, those who have opted Electronics & Communication gallery are in higher percentage as 52%. The other galleries in order of preference are Transport, Physical Science, Periyar and Energy.

From the above observations, the people prefer the modern science & Technology such as Electronics & Communication which is having an edge in the 21st century.

6. Outdoor/ Indoor Exhibits:

Charateristics covered under this category are Inculcation, comparison and concept of out-door exhibition like Science Parks. Table VI and Histogram No.16,18 and 20 represent the statistics of the above characteristics. 89% of visitors agree that the concept of Science Centre like this inculcates curiosity among the children for their learning.

67% of visitors consider this Science Centre as equivalent to other visiting places, while 80% consider this Science Centre as a Learning Centre. From this, it can be concluded that the Science Centre is a place of visit for learning with enjoyment and fun. Concept of Exhibition without any boundary walls like Science Parks is mostly welcomed and accepted by 79% of the visitors. They prefer to enjoy & learn the science along with nature.

42. "THE NEW BOOK OF POPULAR SCIENCE", Vol. 2, Earth Sciences, Energy, Environmental Sciences, Grolier Incorporated; 1984.

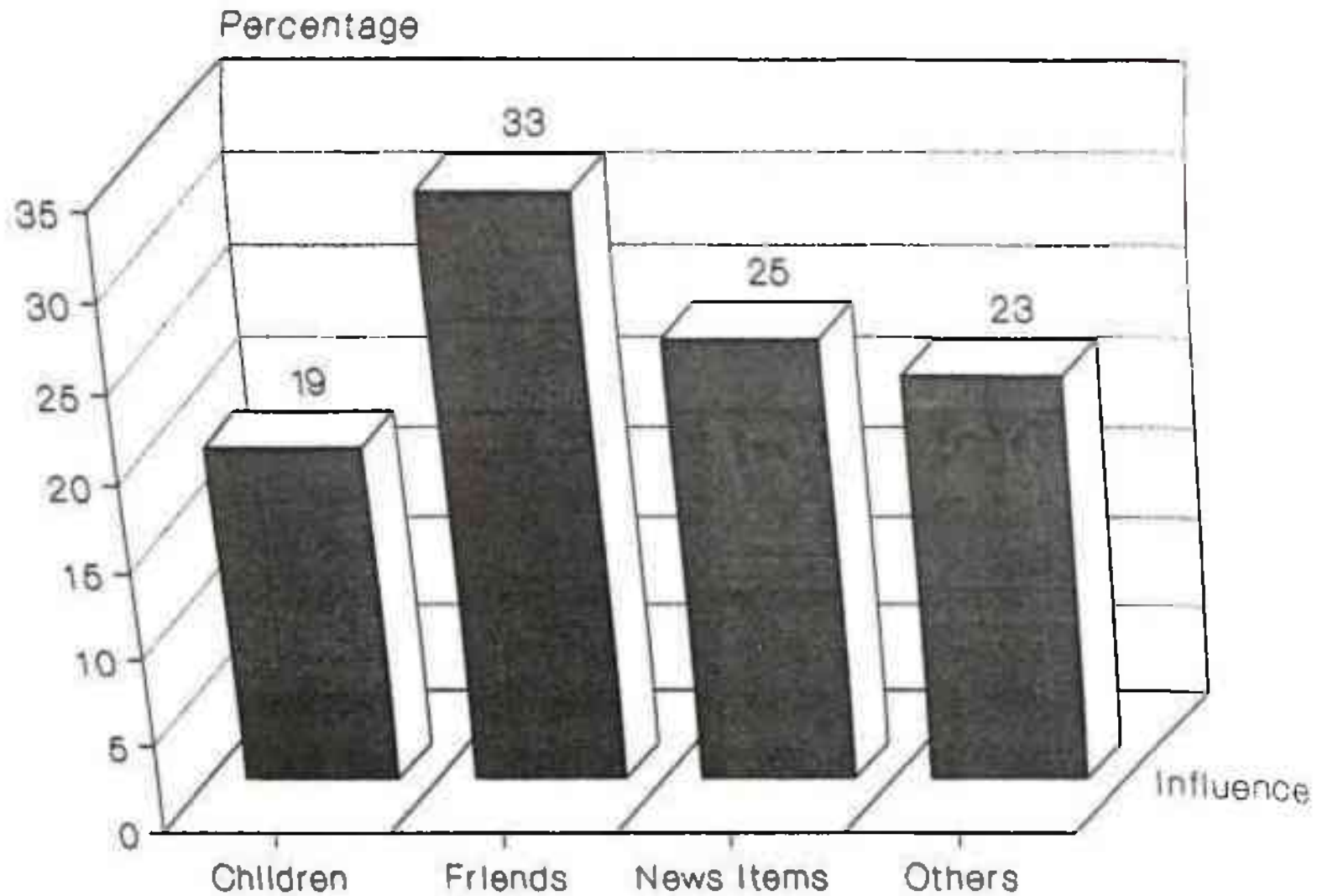
43. "THE NEW BOOK OF POPULAR SCIENCE", Vol. 2, Earth Sciences, Energy, Environmental Sciences, Grolier Incorporated; 1984.

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Conclusion:

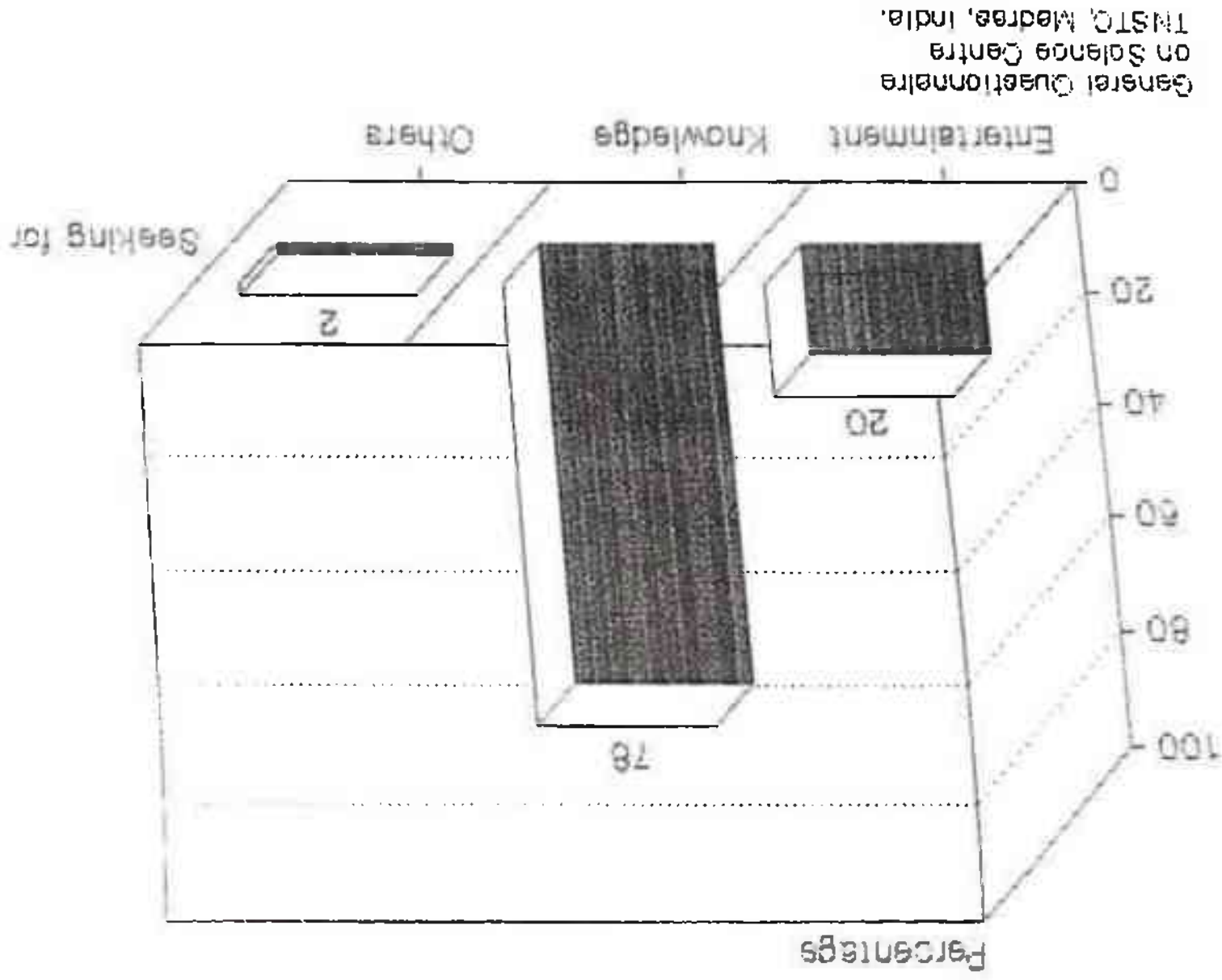
From the above Data analysis, it is to be stressed that many more Science Centres have to be established in future with the modern subjects on Science & Technology so that many children, students, Teachers and public will be benefited with little cost, more knowledge in a short span of life time. For this, efforts are already on war-foot in India by the Central Government, State Government, Public and Private Enterprises. In additon to the above, many interrelated activities such as Temporary exhibition competition, Quiz programmes, Seminars by Experts, Painting competition and Workshop on fabrication of Teaching aids from the available materials may also be conducted by the Science Centres for proper popularisation of Science & Technology.

04. Influence to visit Science Centre

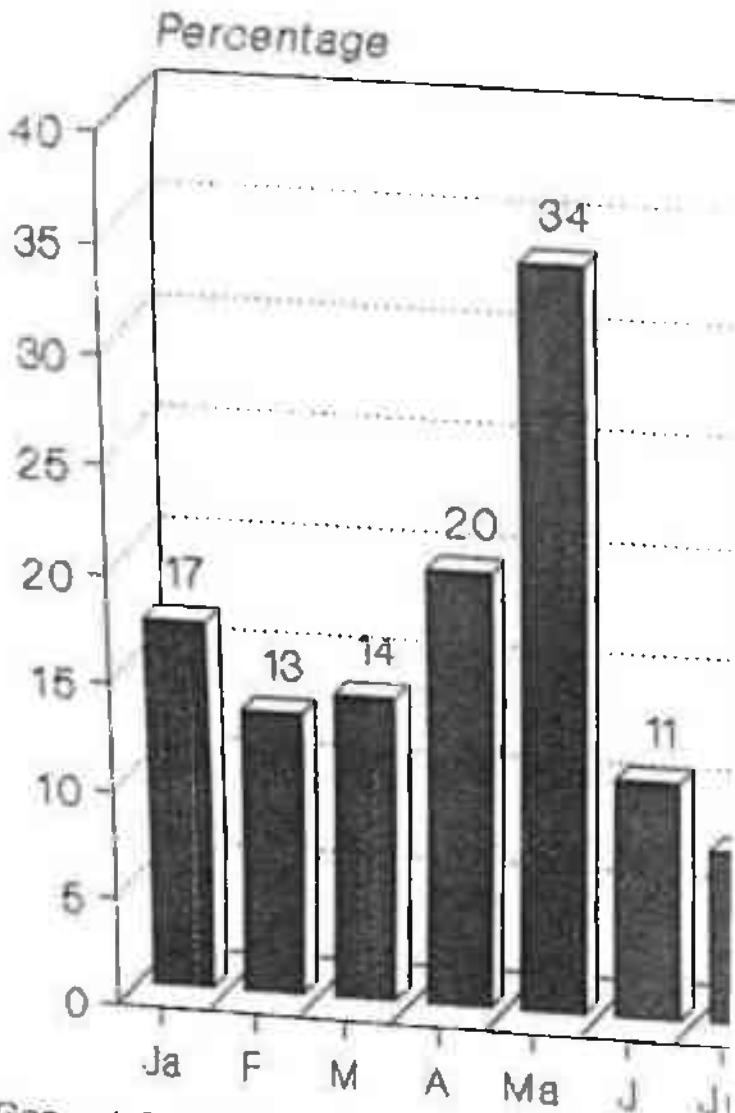


General Questionnaire
on Science Centre
TNSTC, Madras, India.

05. Seeking for

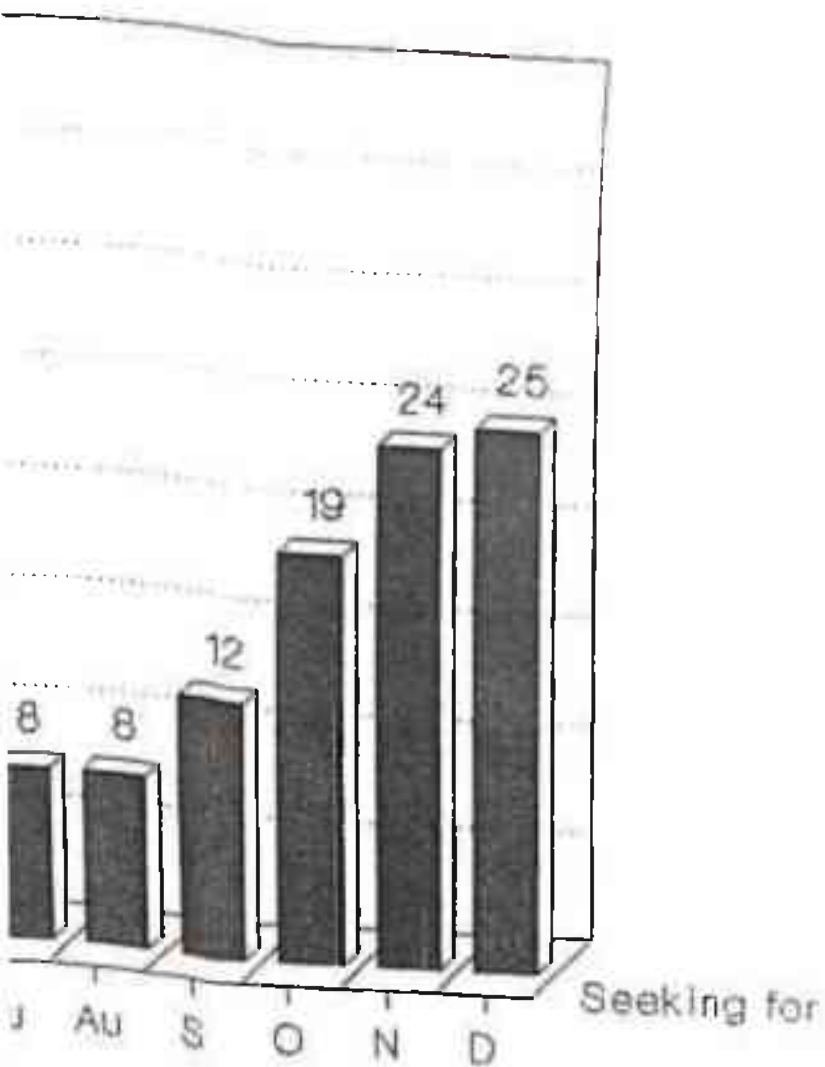


General Questionnaire
on Science Centre
INSTQ, Madras, India.

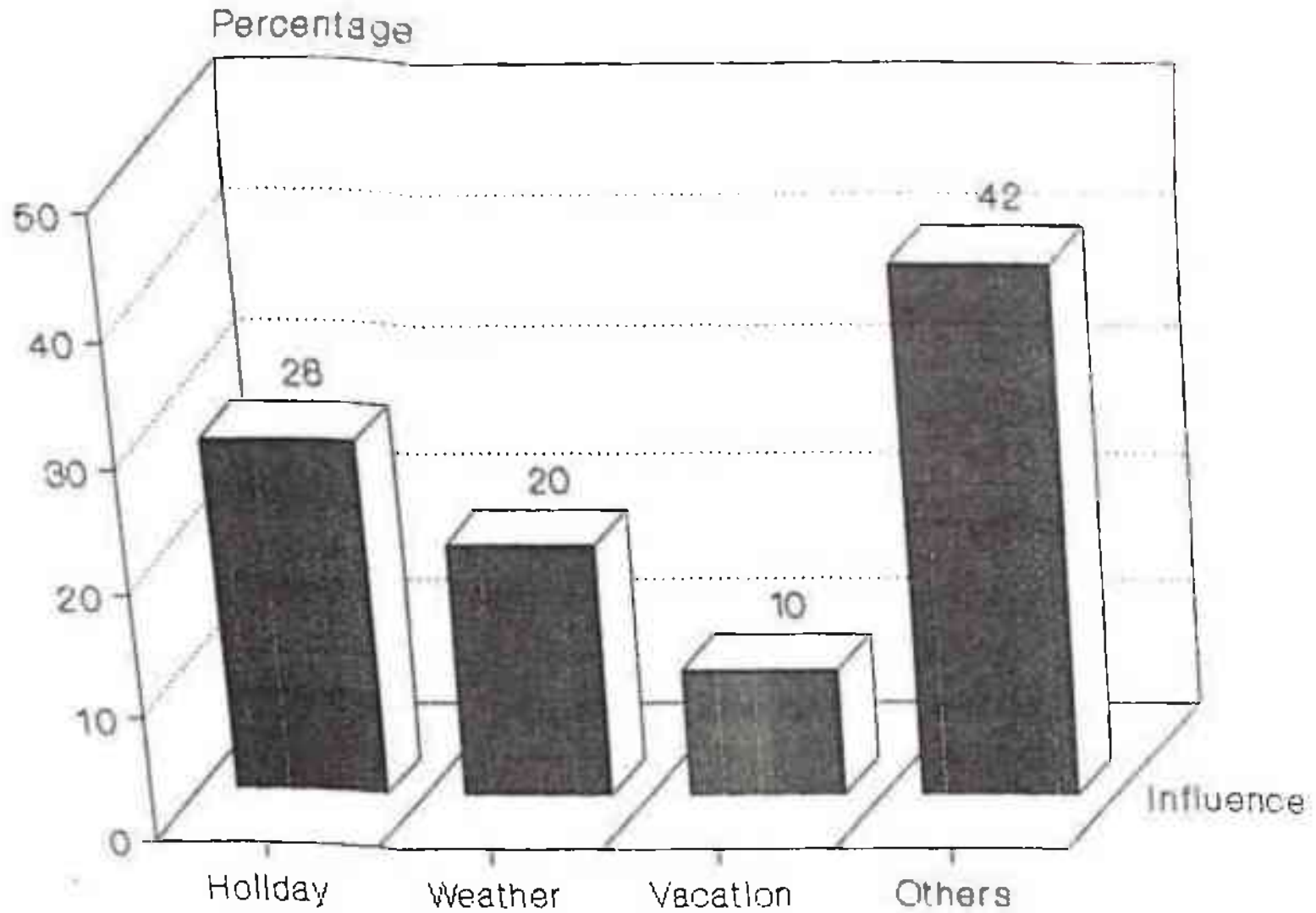


General Questionnaire
on Science Centre
TNSTC, Madras, India.

Visiting Months

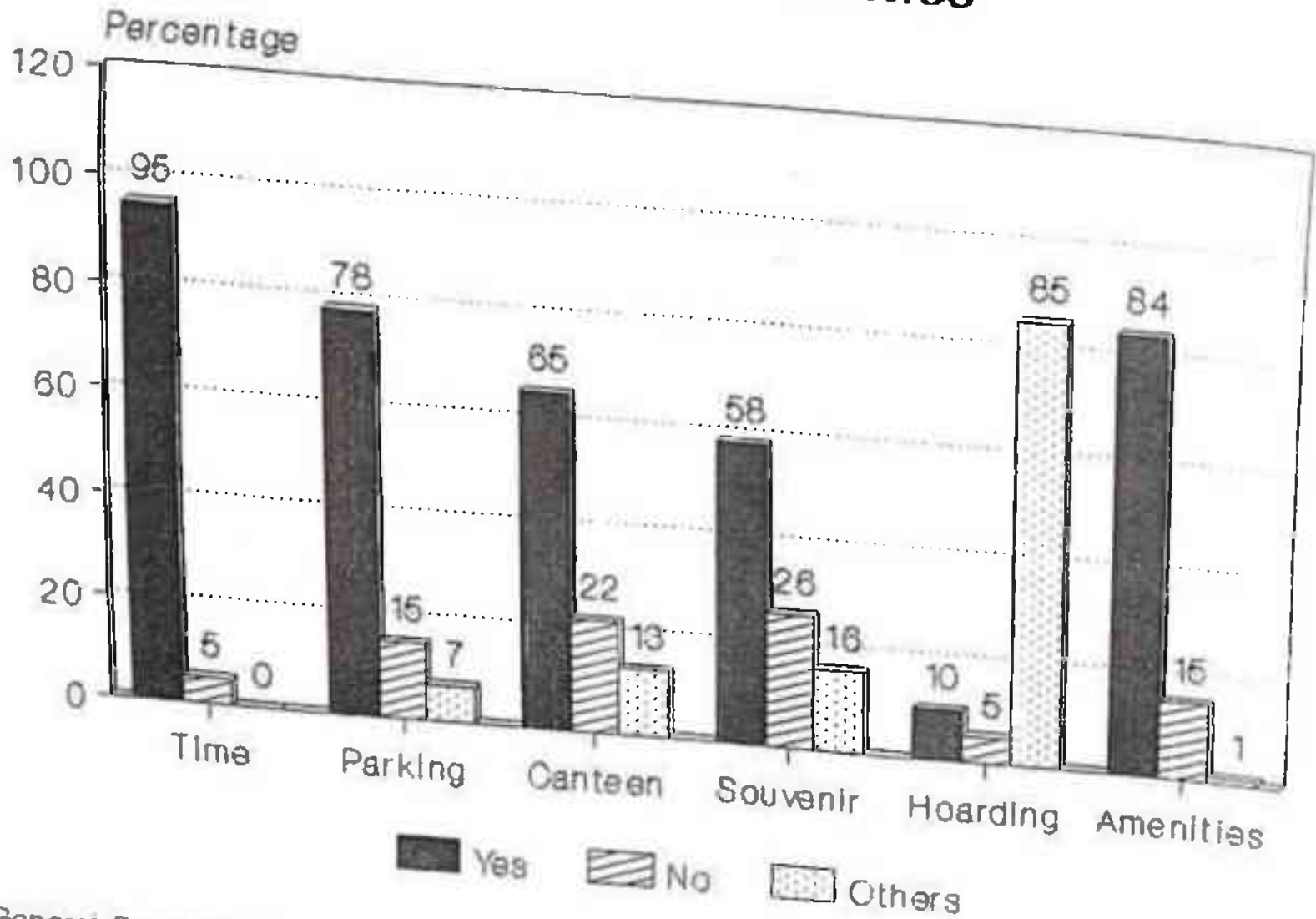


06 (b). Reason for Visiting Months



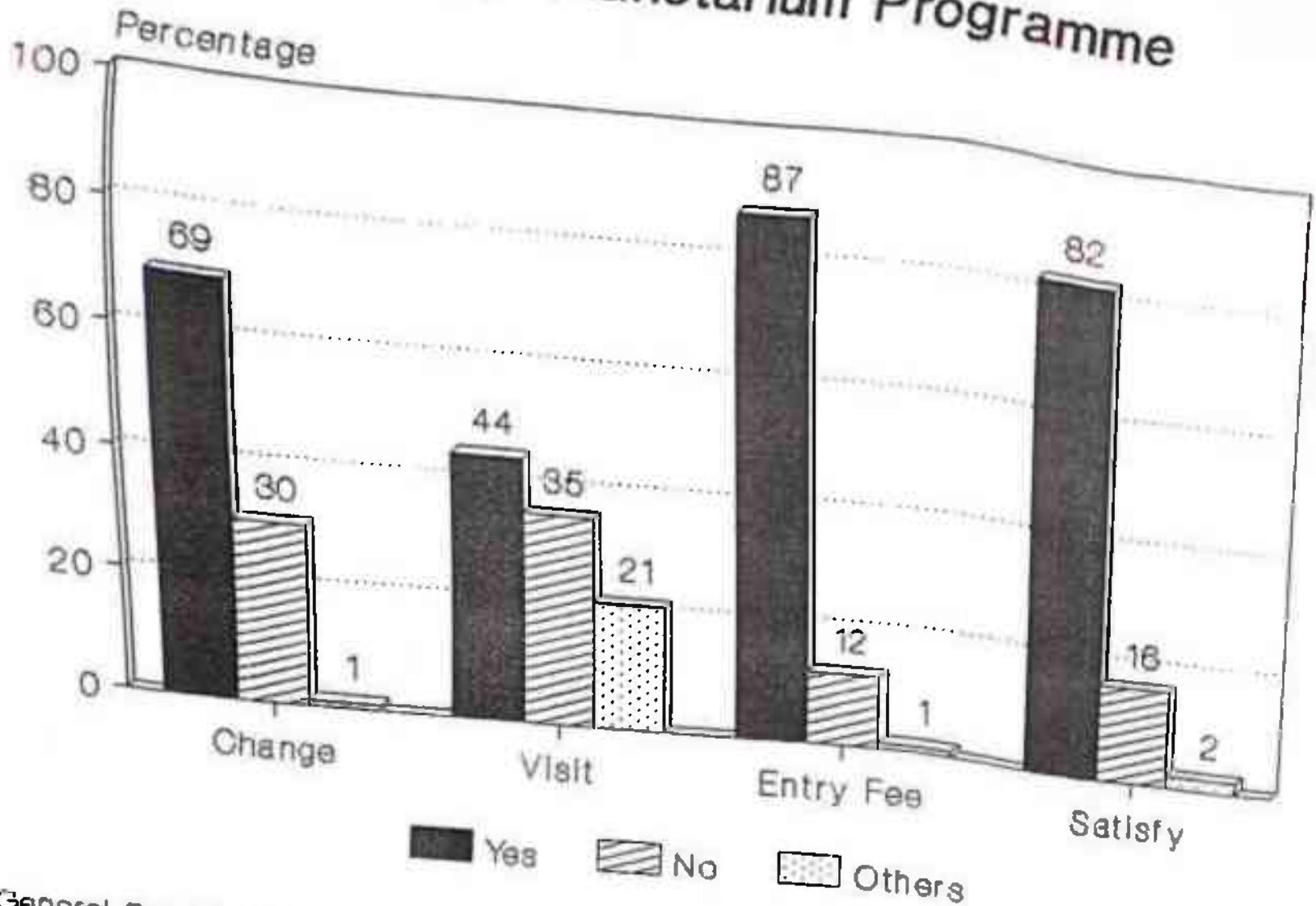
General Questionnaire
on Science Centre
TNSTC, Madras, India.

07 to 12. Facilities



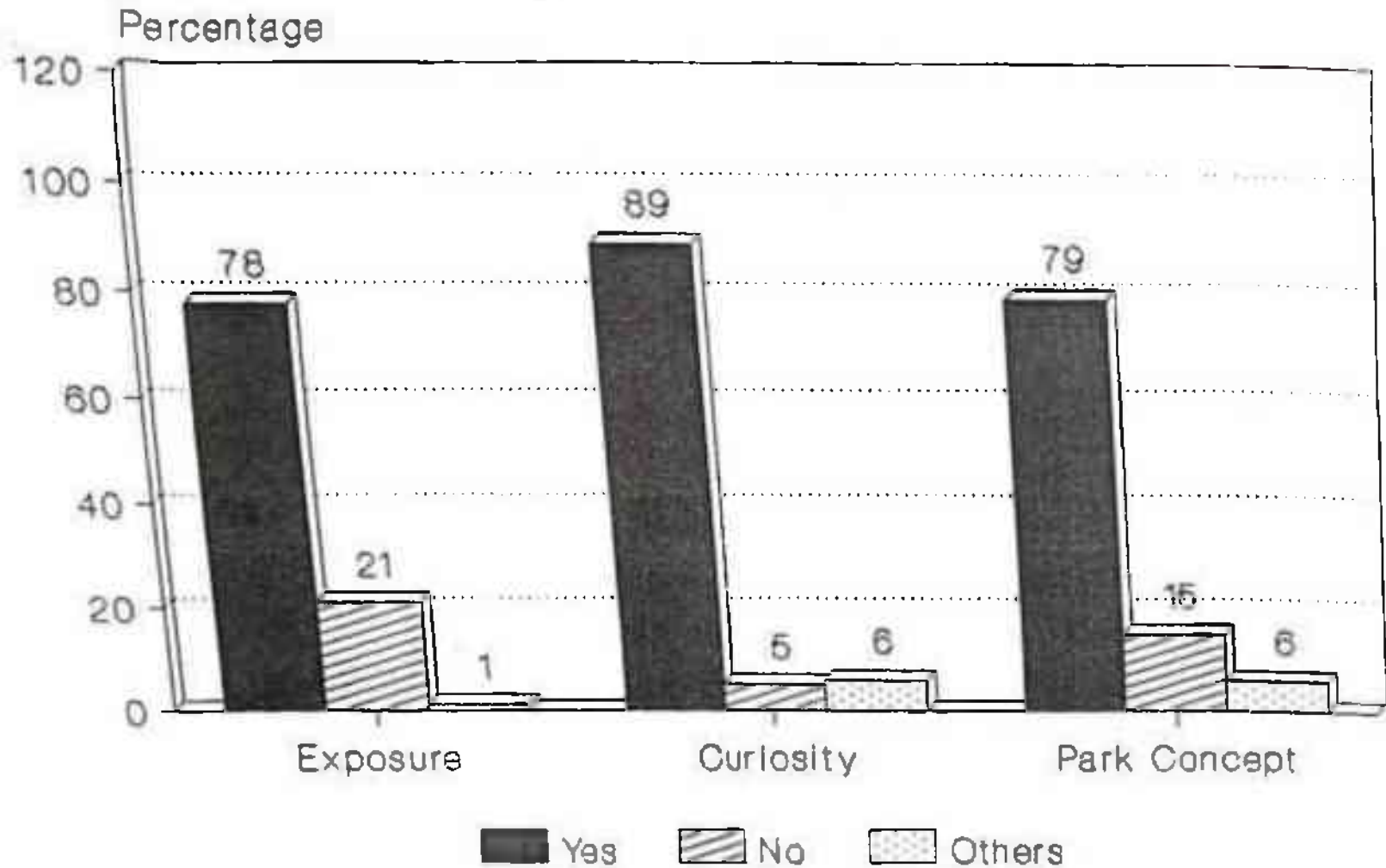
General Questionnaire
on Science Centre
TNSTC, Madras, India.

13 to 15. Planetarium Programme



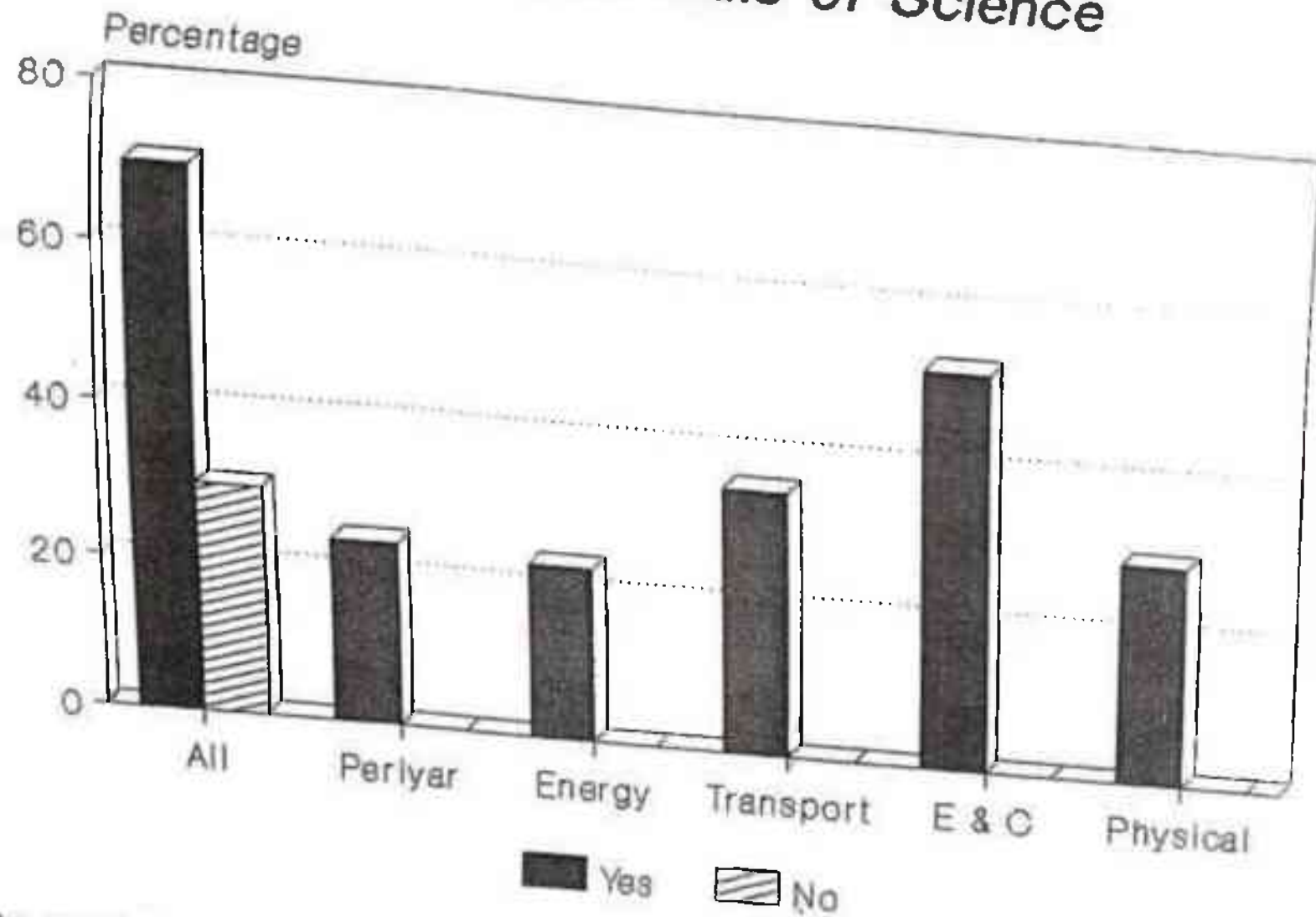
General Questionnaire
on Science Centre
TNSTC, Madras, India.

16, 18 & 20. Science Exhibits and Park.



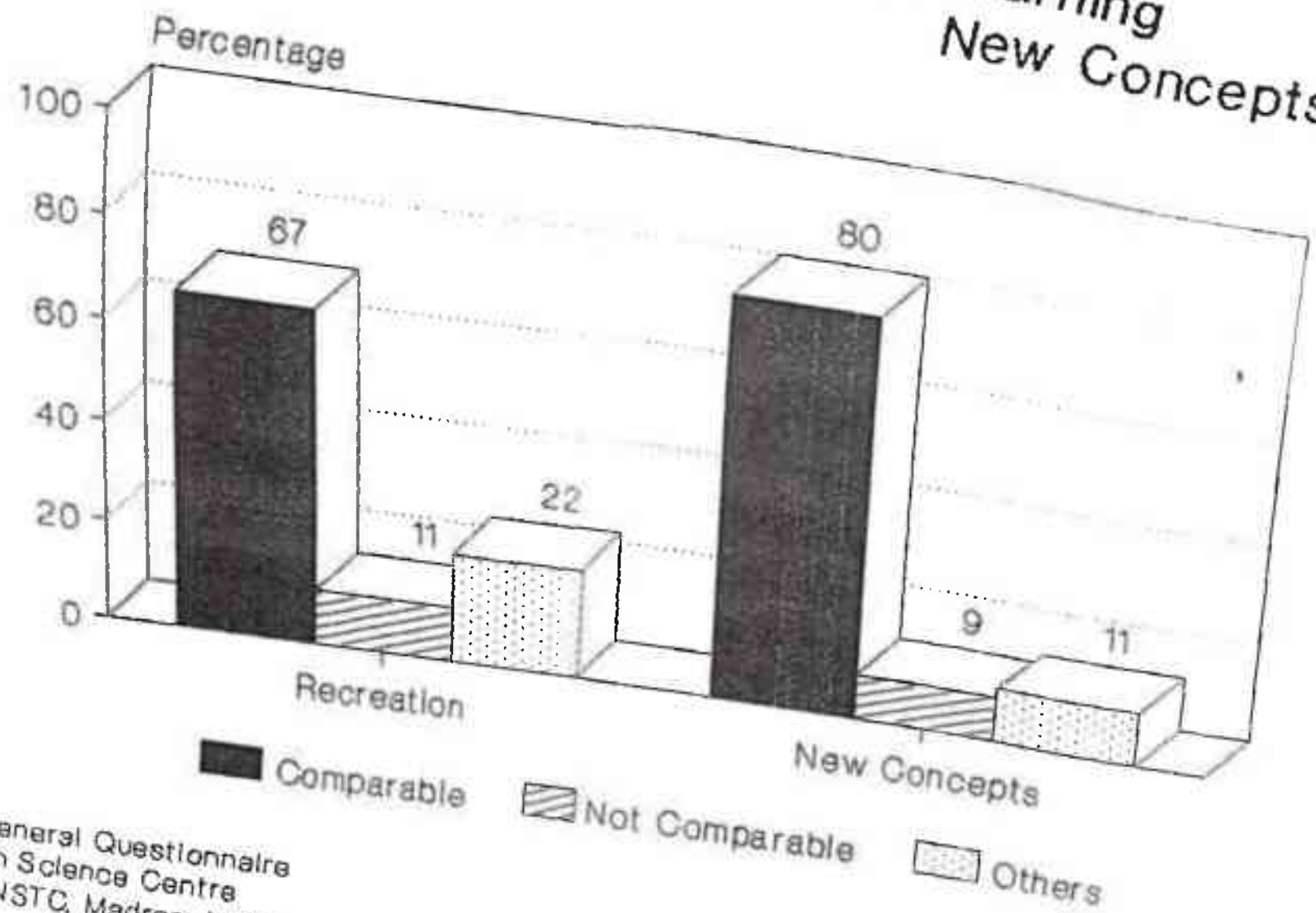
General Questionnaire
on Science Centre
TNSTC, Madras, India.

17 (a & b). Halls of Science



General Questionnaire
on Science Centre
TNSTC, Madras, India.

19 (a & b). Recreation/Learning New Concepts



General Questionnaire
on Science Centre
TNSTC, Madras, India.

TABLE 1 DATA ON DEMOGRAPHIC VALUES OF VISITORS ON
 "QUESTIONNAIRE ON SCIENCE CENTRE" (IN PERCENTAGE)

ADULTS		STUDENTS		GRADUATE (G)		TERRITORY		EMPLOYMENT	
66		34							
MALE	FEMALE	MALE	FEMALE	>=G	<G	LOCAL (MADRAS CITY)	OTHER PLACES	EMPLOYED	NOT EMPLOYED
48	18	20	14	76	24	44	56	53	37

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TABLE II FACTORS VIEWED BY VISITORS: (IN PERCENTAGE)

INFLUENCE				SEEKING FOR			PRESENT TIMING		PREFERABLE VISITING MONTHS							
C	F	N	O	E	K	O	YES	NO	Summer		Rainy		Autumn		Winter	
									65	28	68	44				
									APR MAY JUN	JUL AUG SEP	OCT NOV DEC	JAN FEB MAR				
19	33	25	23	20	78	82	95	05	20 34 11	08 08 12	19 24 25	17 13 14				

ABBREVIATION EXPANSION: C - CHILDREN; F - FRIENDS; N - NEWSITEM; O - OTHERS
 E - ENTERTAINMENT; K - KNOWLEDGE

TABLE - III FACILITIES:- (IN PERCENTAGE)

VEHICLE PARKING PATES			CANTEEN			AD FACILITY			CIVIC AMENITIES			SOUVENIR		
Y	N	O	Y	N	O	Y	N	O	Y	N	O	Y	N	O
78	15	7	65	22	13	10	5	85	84	15	1	58	26	16

ABBREVIATION EXPANSION: Y - YES. N - NO. O - OTHERS.

TABLE- IV: PLANETARIUM AND EXHIBITION

Awareness of Change in planetarium programmes.			Visiting the Planetarium often.			Reasonability of Entry fees for Science Centre & Planetarium.			Satisfied With the Programme.			Satisfied With the Exhibits.		
Y	N	O	Y	N	O	Y	N	O	Y	N	O	Y	N	O
59	30	01	44	35	21	87	12	01	82	16	02	78	21	01

ABBREVIATION EXPANSION: Y - YES. N - NO. O - OTHERS.

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TABLE - V HALLS OF EXHIBITION: (COMPARISON)

Number of Visitors to all Halls of Science Centre		INDIVIDUAL LIKING OF HALLS OF SCIENCE CENTRE				
		Periyar/ Int. Dolls Exhi.	Energy	Transport	Electronics & Communication	Physical Science
Yes	Other					
70	30	24	23	35	52	29

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TABLE: VI OUTDOOR / INDOOR EXHIBITS

Will Science Centre inculcate curiosity in children?			Comparison of Science Centre to other places						Concept of Out-Door Exhibits at Science Park		
			Recreation			Learning					
Y	N	O	C	NC	O	C	NC	O	Y	N	O
89	05	06	67	11	22	80	09	11	79	15	06

ABBREVIATION EXPANSION:

Y - YES; N - NO; O - OTHERS; C - COMPARABLE; NC - NON-COMPARABLE

Appendix No. 02

On

"Science Exhibits"

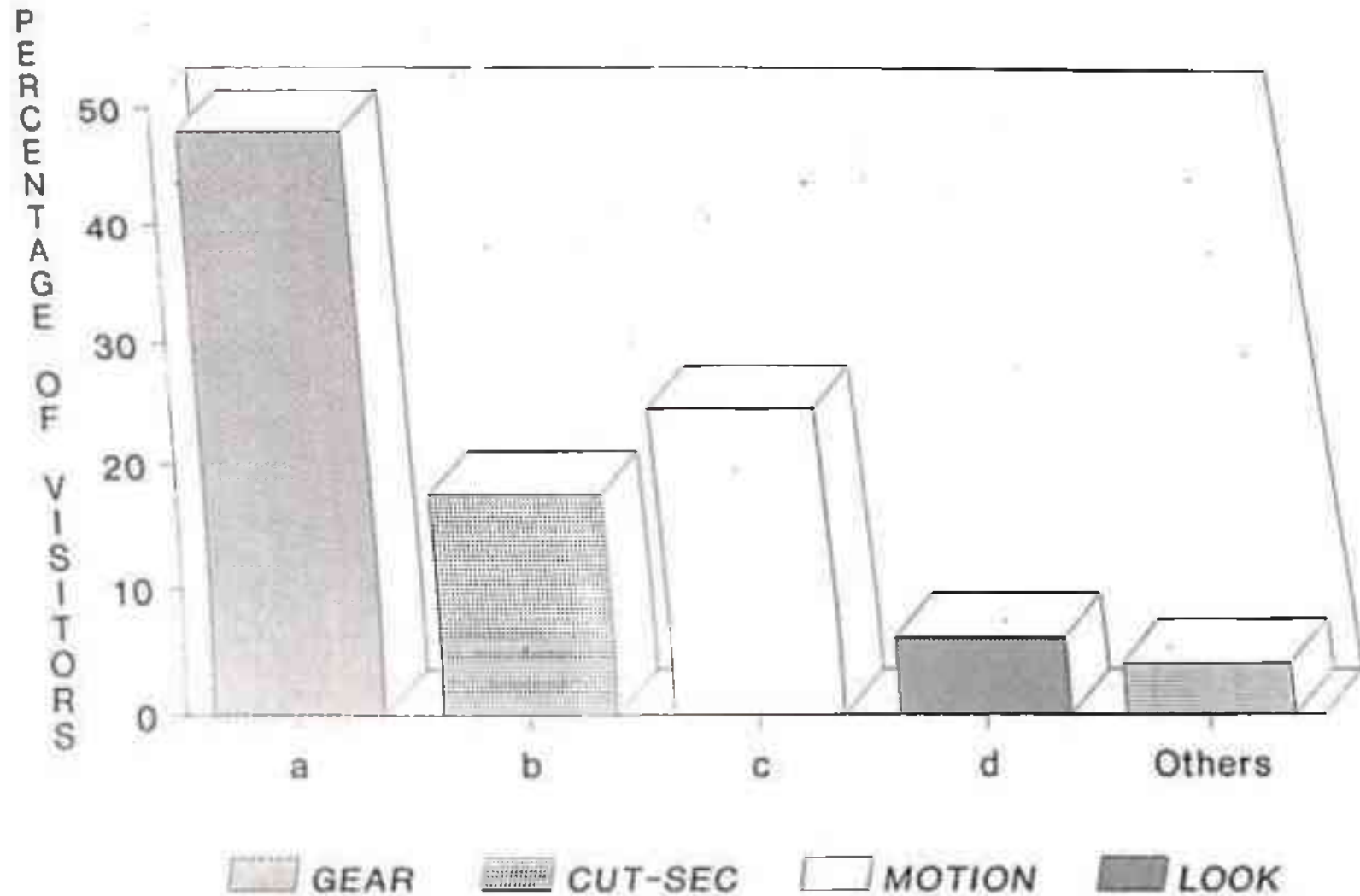
TAMILNADU SCIENCE AND TECHNOLOGY CENTRES, MADRAS- 600 025.
 QUESTIONNAIRE - II (On Exhibits)

Note :

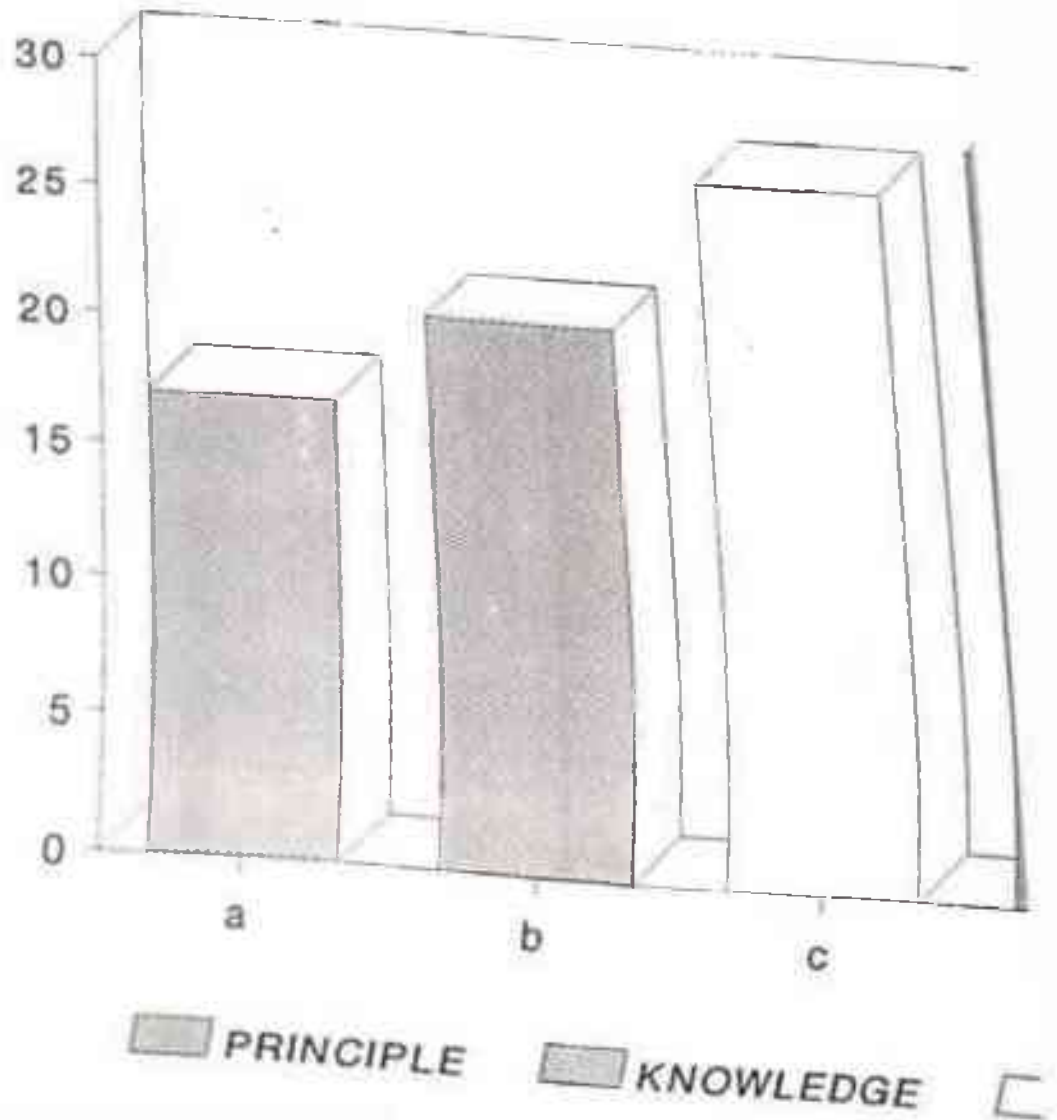
1. Kindly strike out the answer which is not applicable.
2. Please be brief in your comments remarks. Kindly fill in the following questionnaire and submit to Er. R. Madhavan, Joint Director (Electronics) of this Centre

01. Date
02. a. Name
 b. Age
 c. Sex
 d. Occupation
 e. Qualification
03. Where do you come from :
 Madras
 Tamilnadu
 Other Please specify _____
04. Which one of the exhibits displayed in this Science Centre you like most ?
 Highlight your observation. Please mention only one.
05. In the exhibit "BUS-CHASSIS". What influenced you much ?
 a) Gear System
 b) Cut Section
 c) Working in Motion
 d) Aesthetic look
06. In the exhibit "Model Broadcasting Studio", which way you have been induced towards it ?
 a) Explains principle clearly
 b) Entertains and imparts knowledge
 c) As working model
 d) As a replica of AIR Studio
07. In the exhibit "Weights on Different Planets" which aspect of the exhibit impressed you much ?
 a) Display in General
 b) The readings
 c) The number values
 d) To be working on the exhibit
 e) Weigh more in Jupiter
 f) Weigh less in Moon
08. What impressed you most in the "Nuclear Fission" exhibit of Energy gallery ?
 a) Display in General
 b) Lighting Sequence
 c) Effect of splitting of heavier elements
 d) Aesthetic effect
09. In the engine section of Transport gallery, which one of the following you like most ?
 a) Multi Cylinder engine
 b) Ambassador Car engine
 c) Two stroke engine
 d) Wankel engine
 e) Four stroke engine.

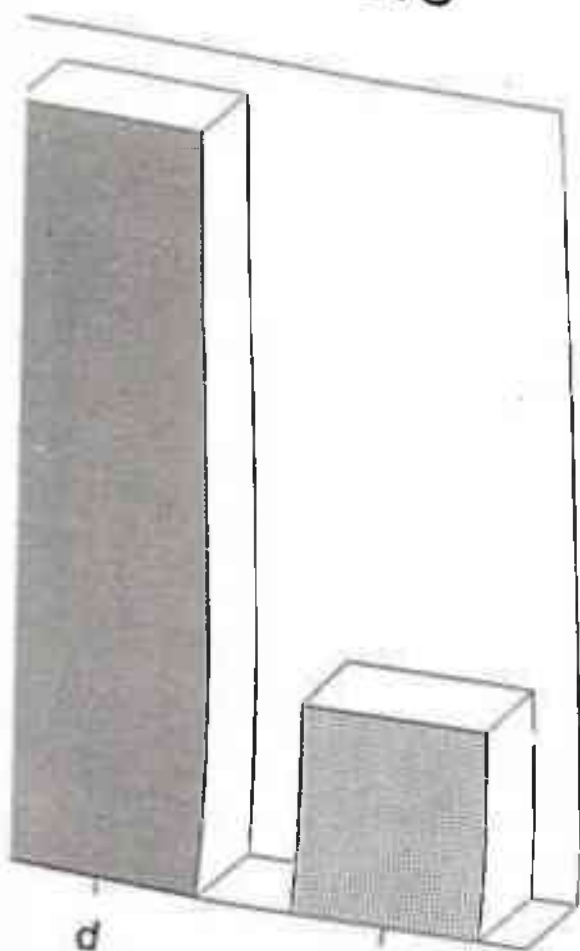
Q:05 BUS-CHASSIS



Q:06 MODEL BROADCASTS



TESTING STUDIO



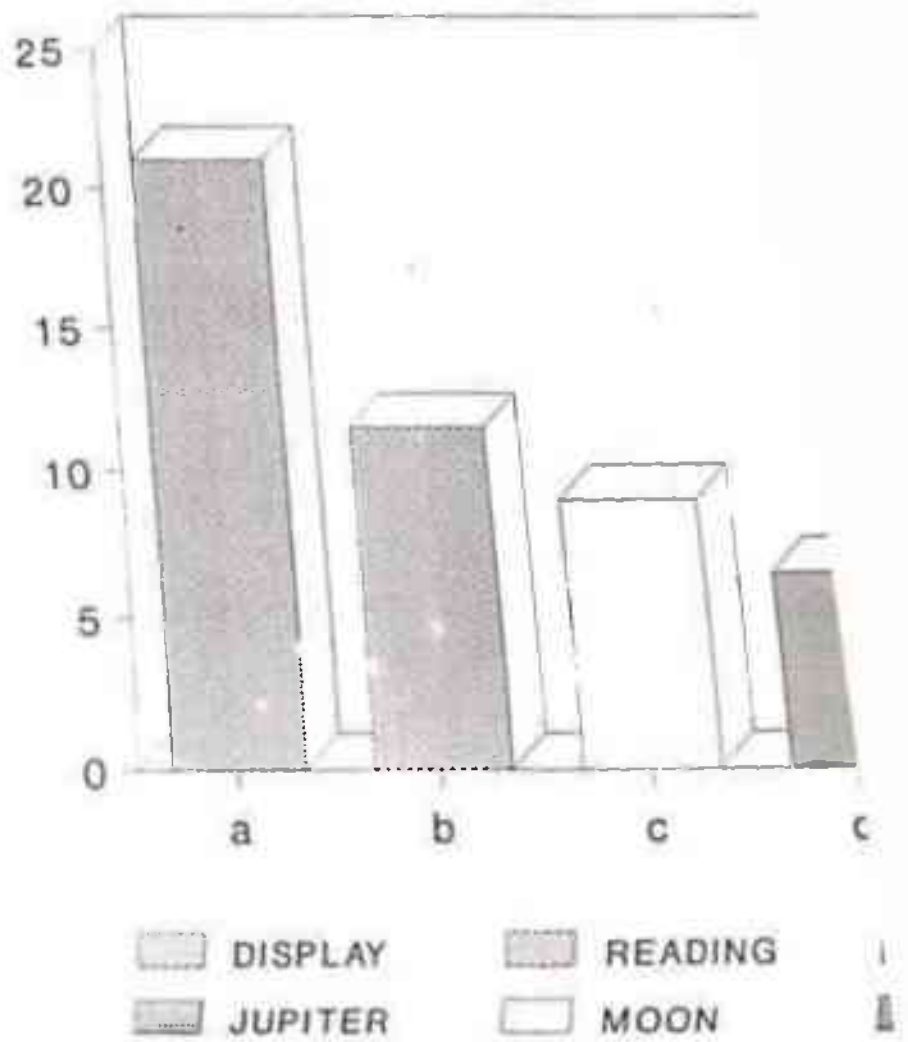
d

Others

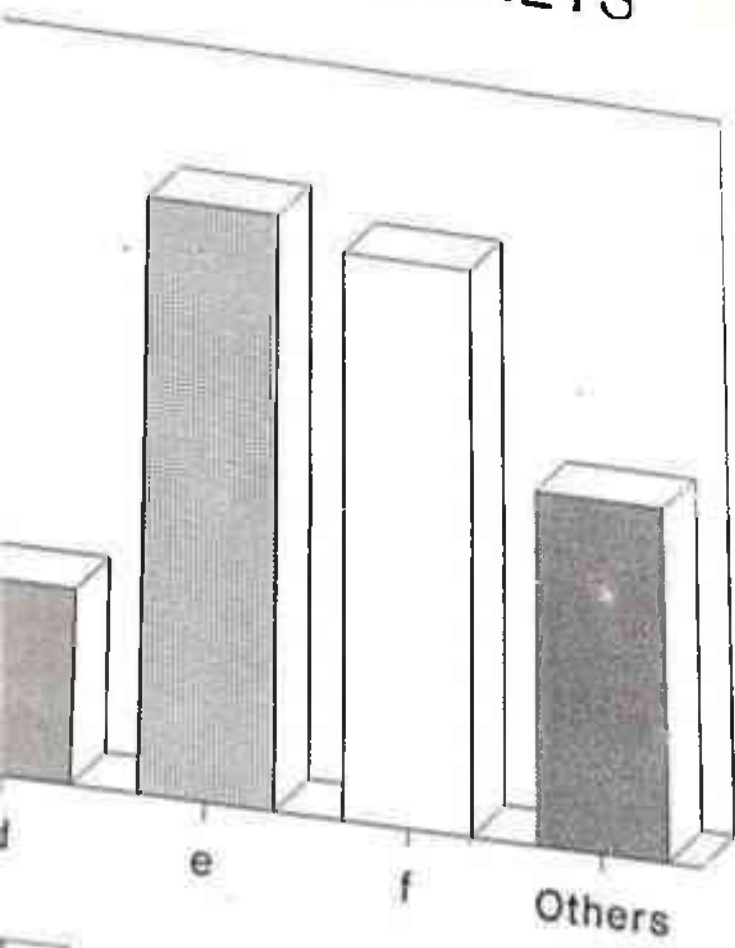
WORK

AIR

Q:07 WEIGHTON L



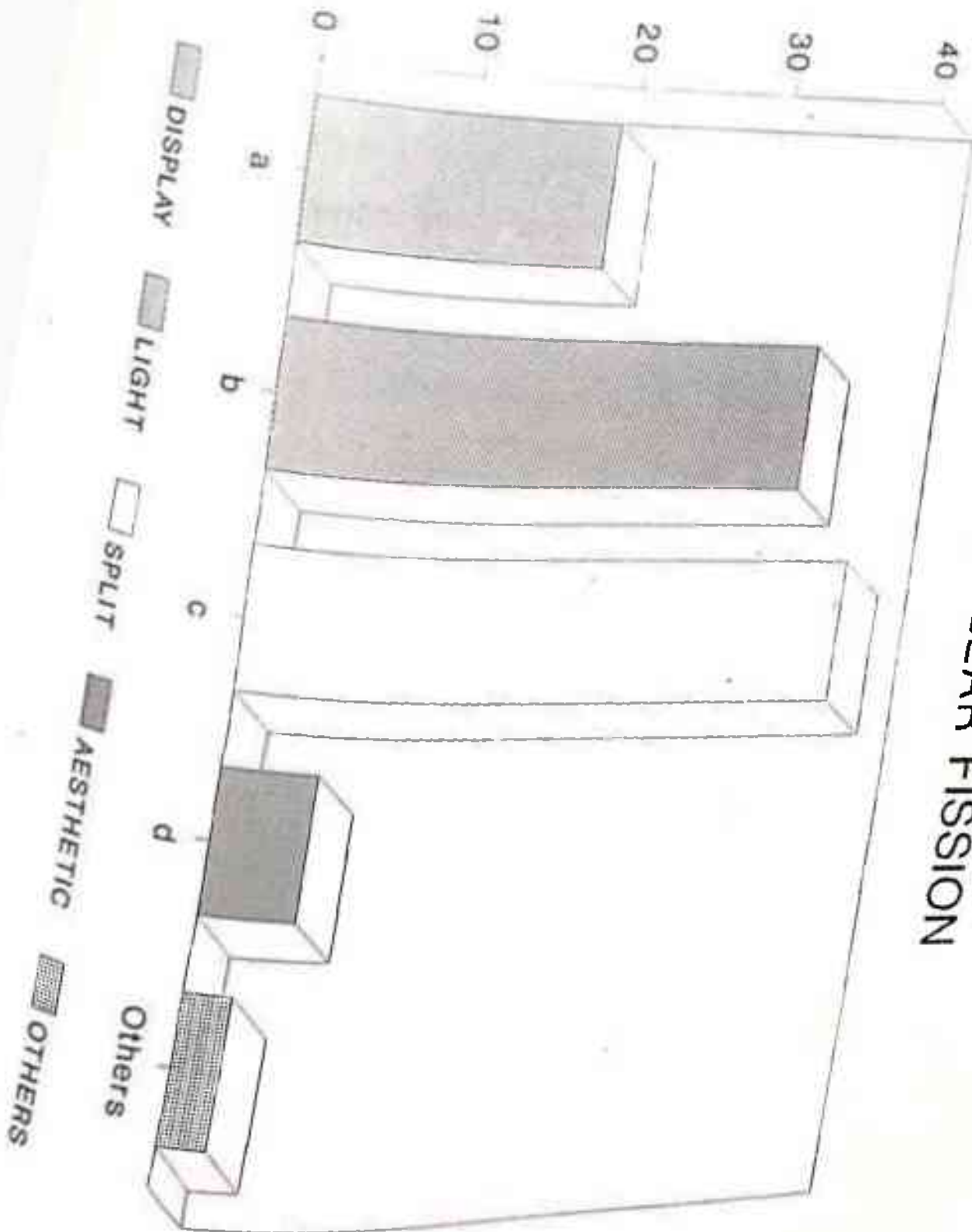
DIFFERENT PLANETS



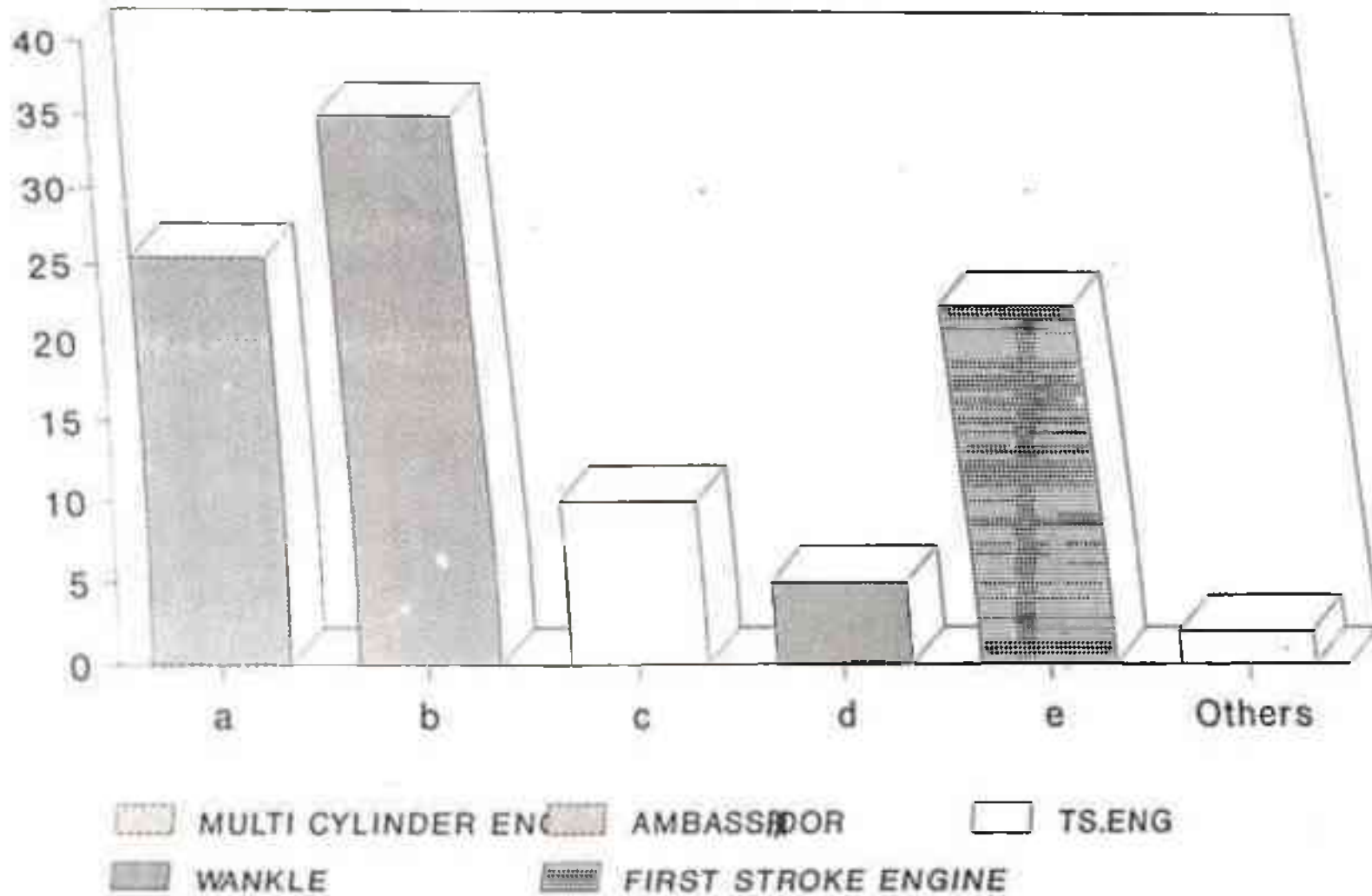
NUMBER
OTHERS

WORK

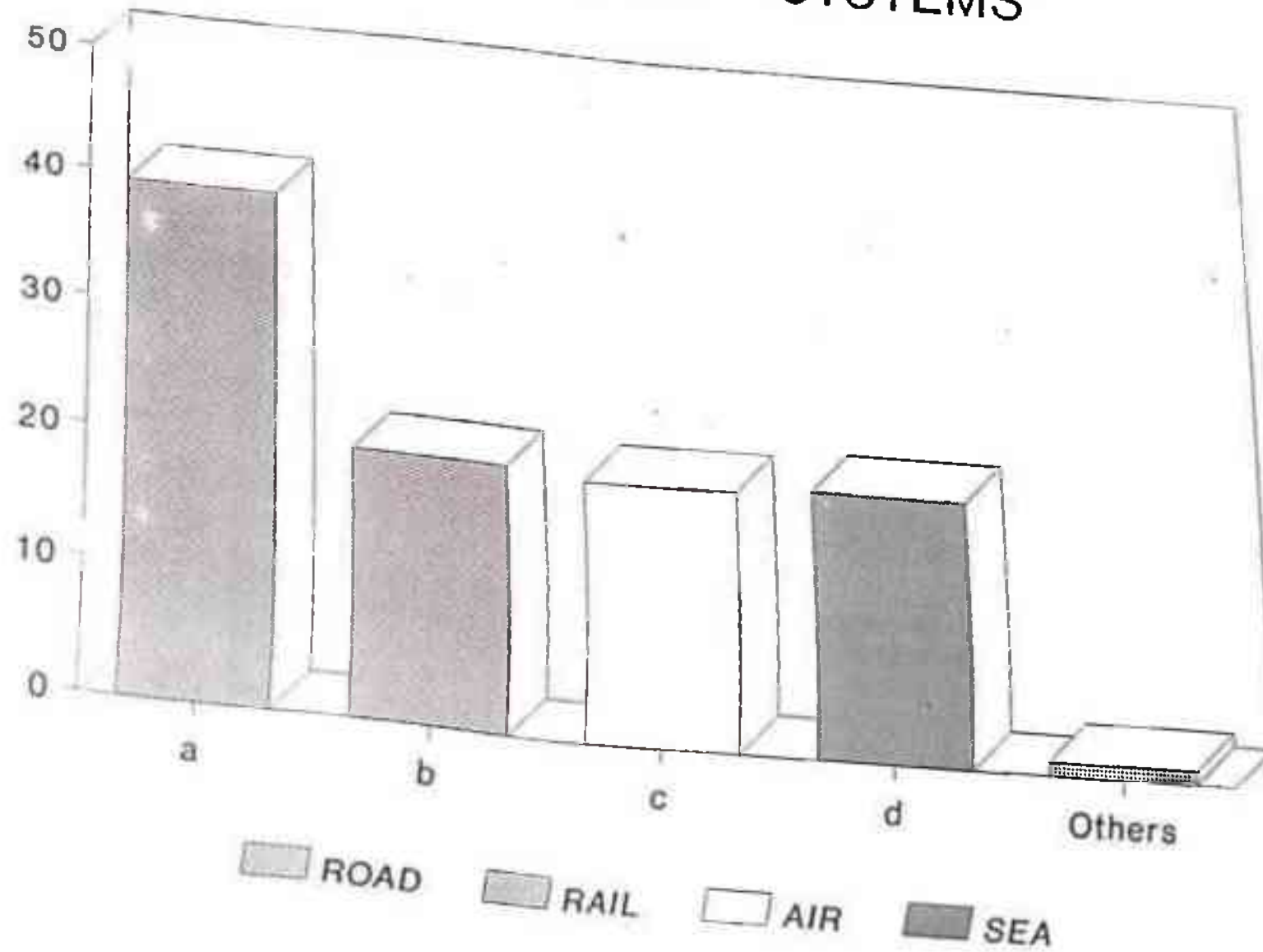
Q:08 NUCLEAR FISSION



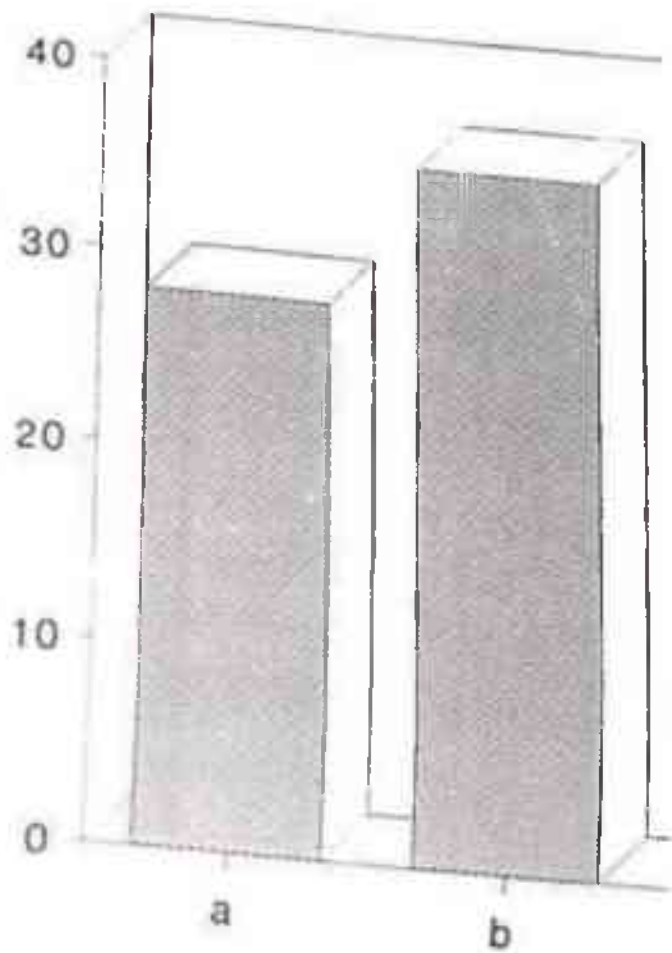
Q:09 ENGINES



Q:10 TRANSPORT SYSTEMS



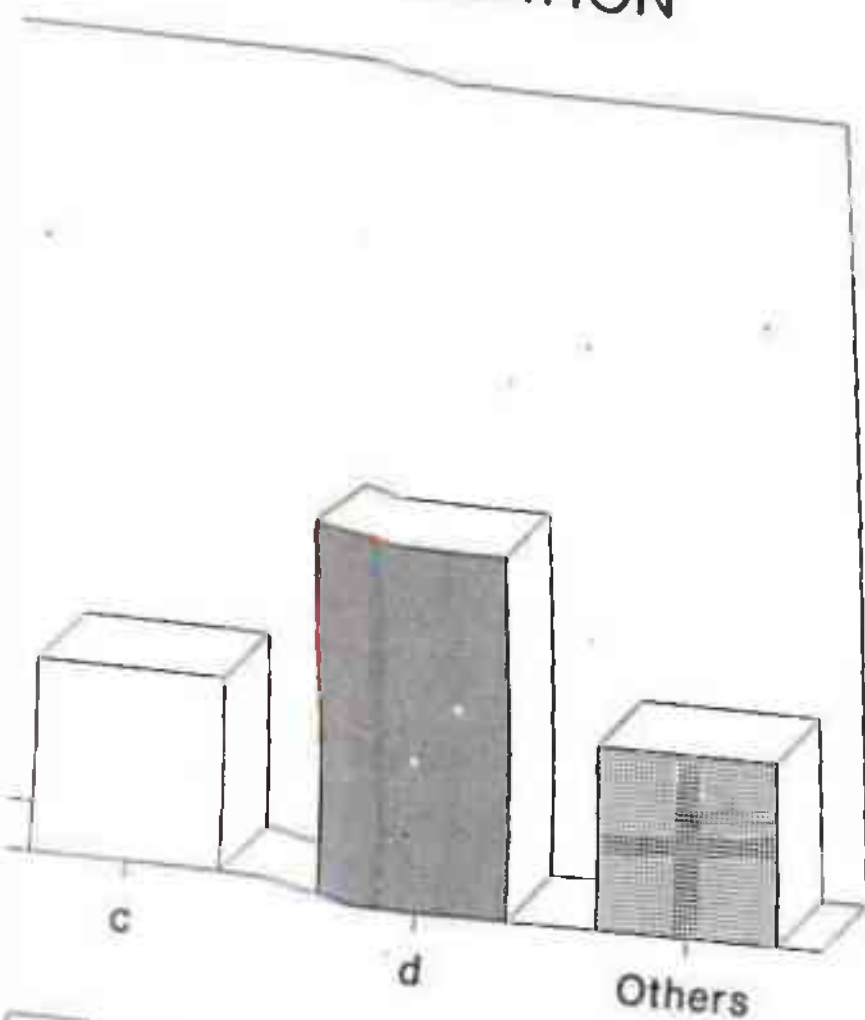
Q:11 SATELL



LED

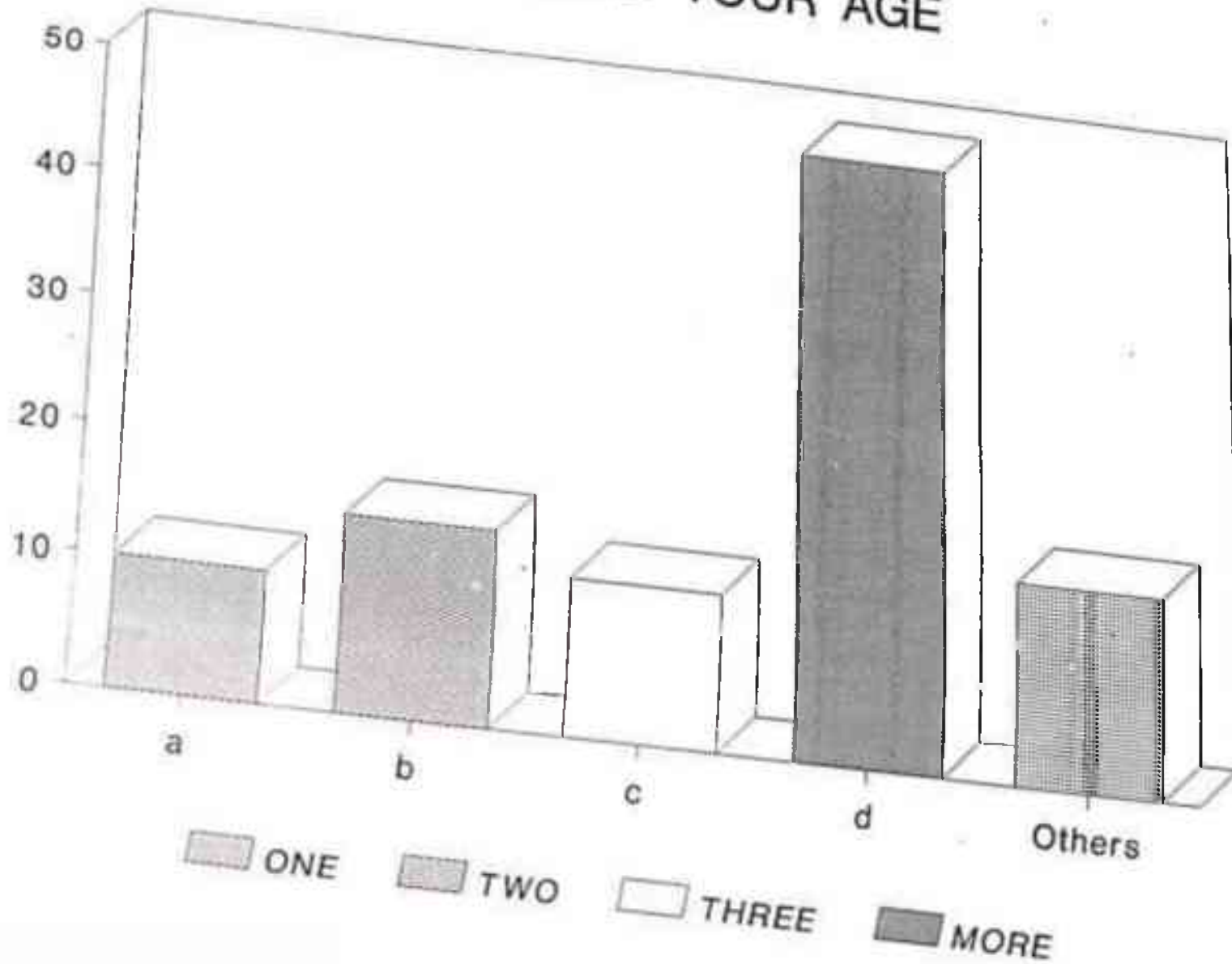
GLOBE

ITE COMMUNICATION

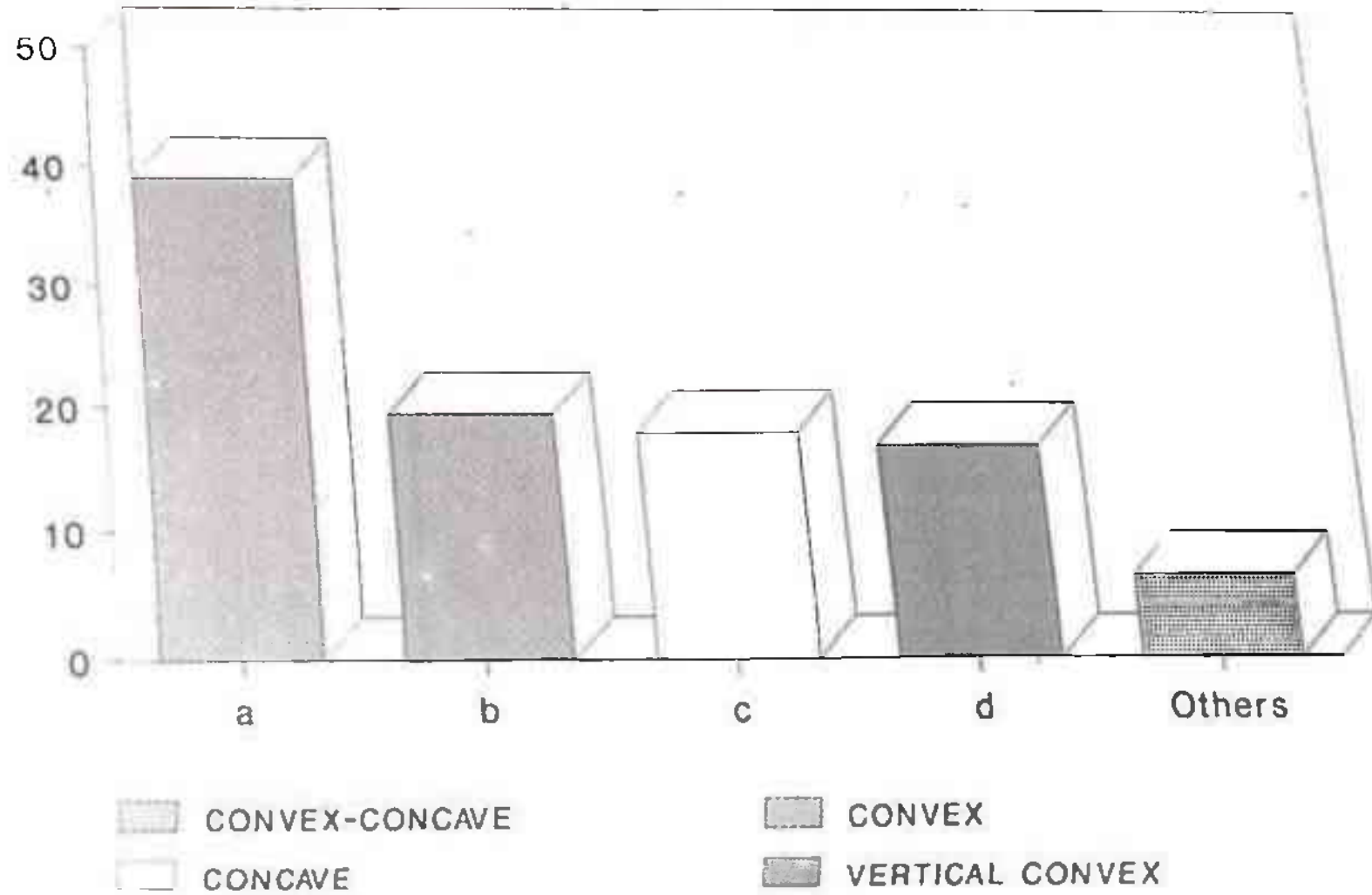


□ BLOCK SCHEMATIC ■ MAP

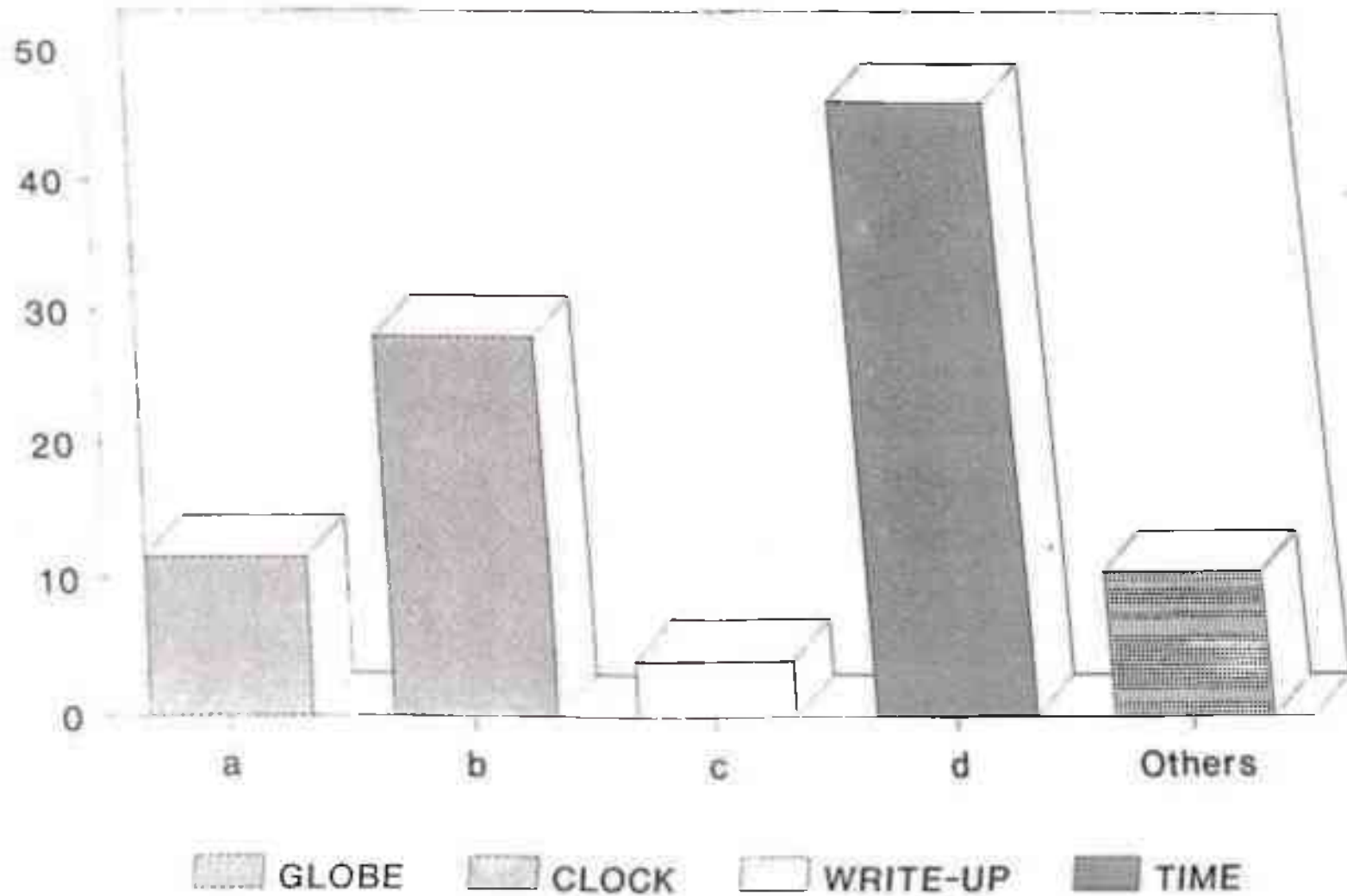
Q:12 FIND YOUR AGE



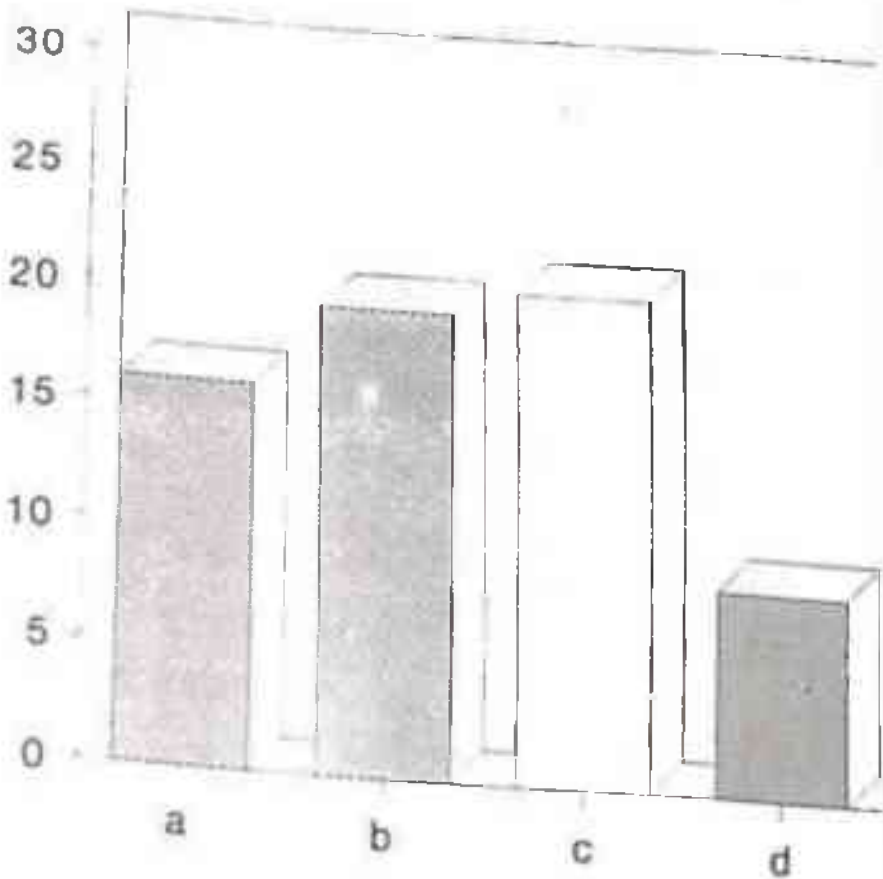
Q:13 FANTASTIC MIRROR



Q:16 WORLD CLOCK



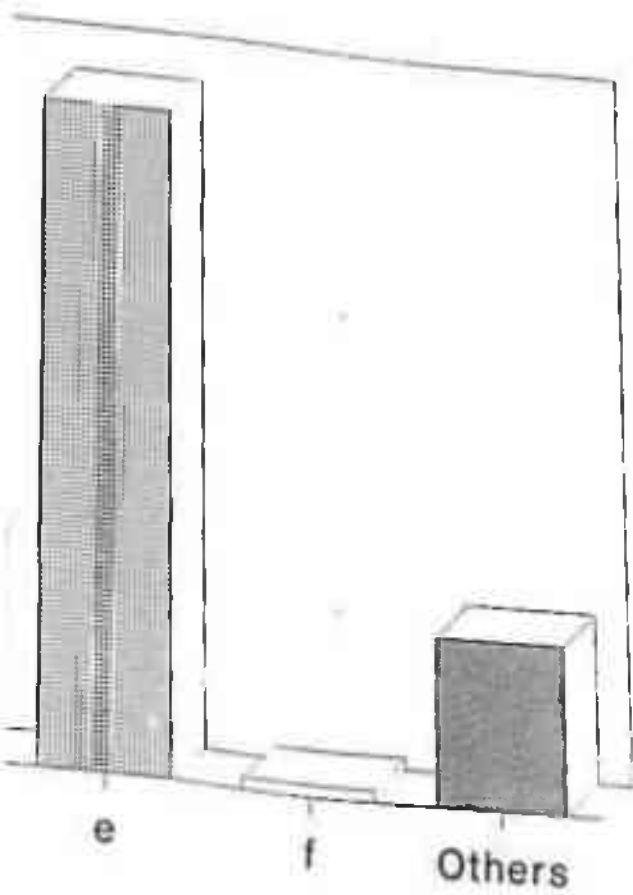
Q:17 CIRCUS C





POTENTIAL
CENTRIPETAL

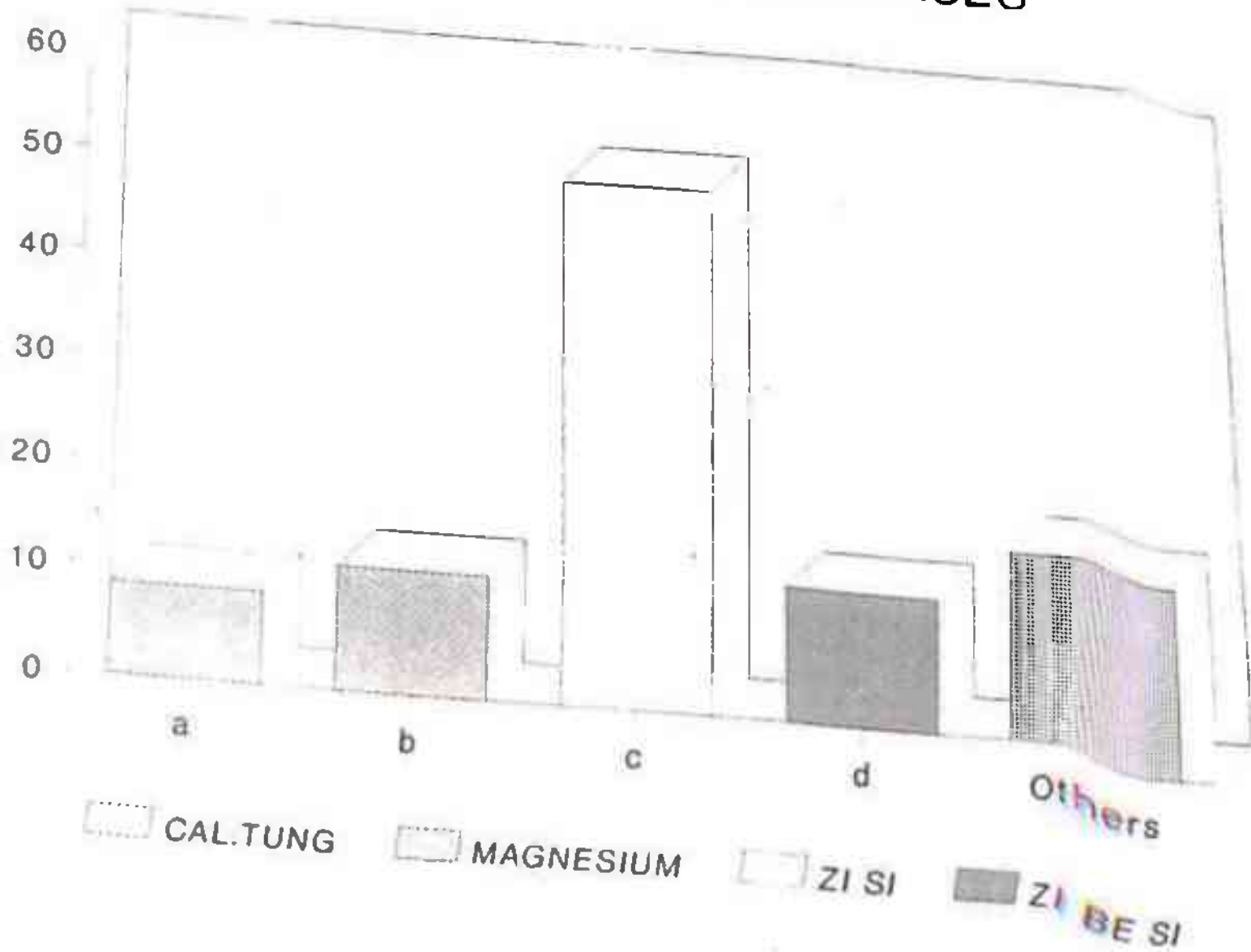
KINETIC
ALL

OF FORCE

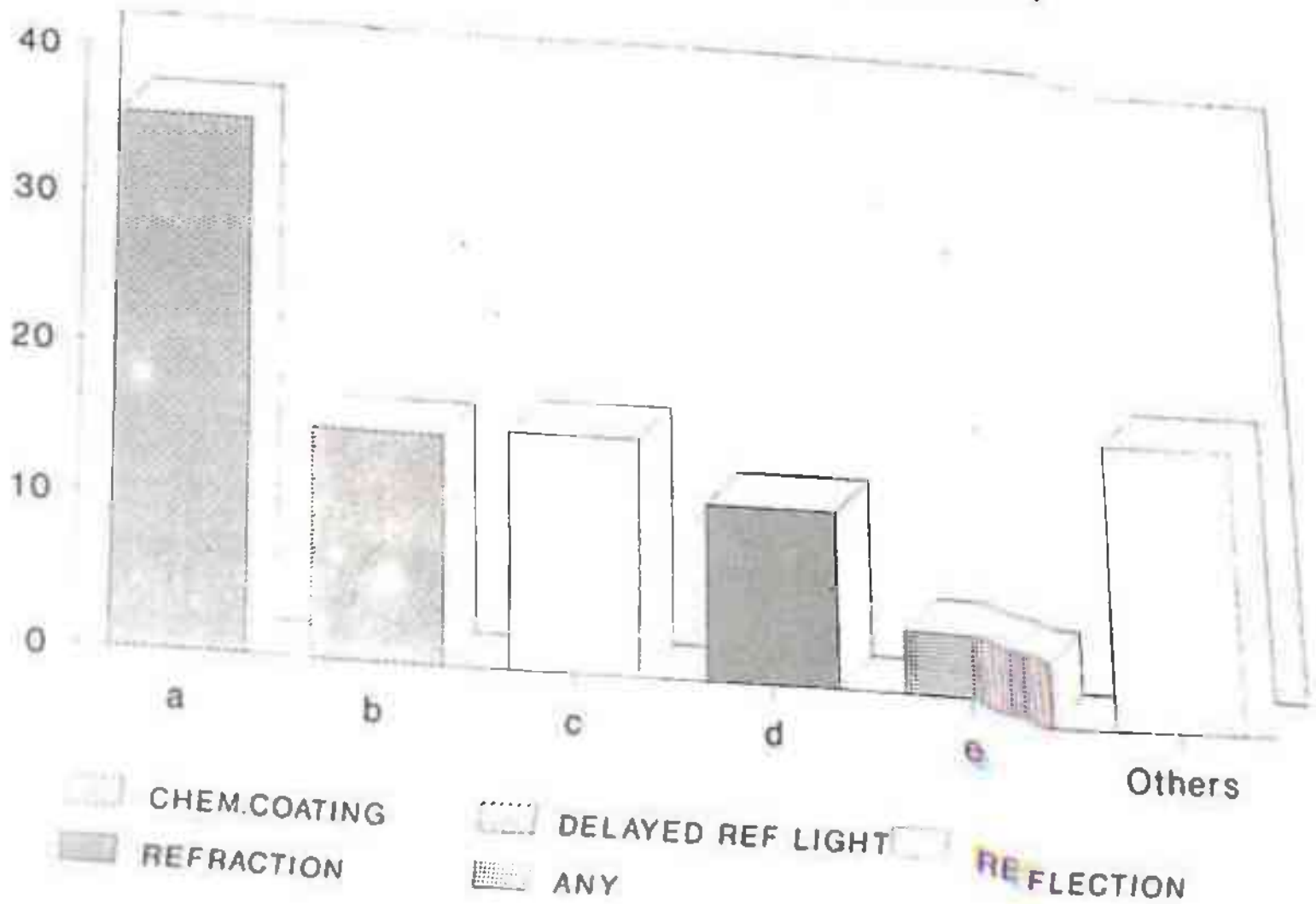


 CENTRIFUGAL
 NONE

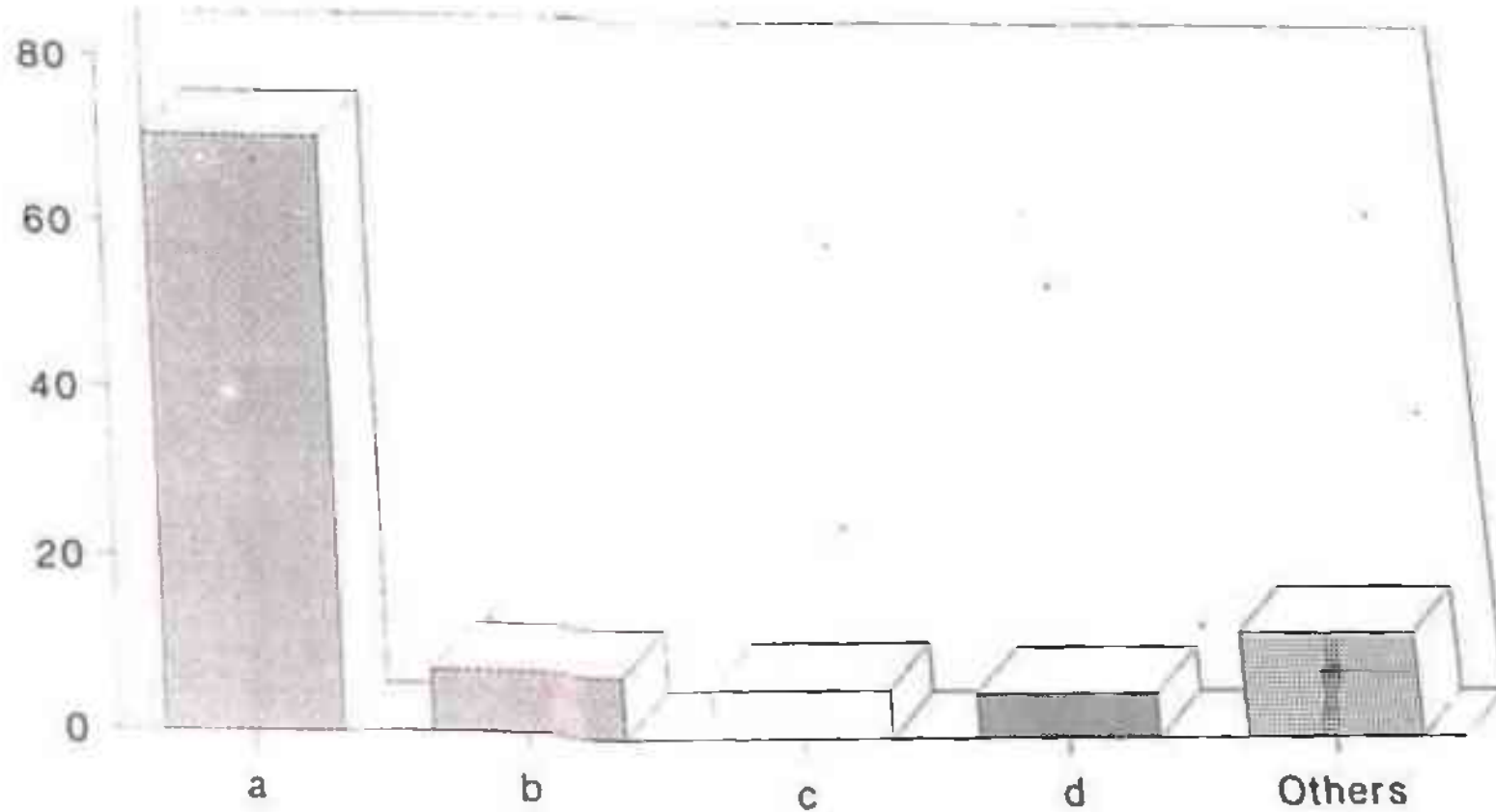
Q:18 COLOURS FROM GASES



Q:19 CATCH YOUR SHADOW



Q:20 PERIODIC TABLE



103 ELEMENTS
102 ELEMENTS

101 ELEMENTS
99 ELEMENTS

Appendix No. 03

On

"Learning Styles"

TAMILNADU SCIENCE AND TECHNOLOGY CENTRES, MADRAS- 600 025.
Questionnaire III (Learning Styles)

Kindly fill in the following questionnaire and submit to Er. R. Madhavan, Joint Director (Electronics) of this Centre. Tick (✓) only one answer in each of the objective questions.

01. Date _____
02. a. Name _____
b. Age _____
c. Sex _____
d. Occupation _____
e. Qualification _____
03. Where do you come from :
Madras
Tamilnadu
Other Please specify _____
04. What is your Professional interest ?
a) Popularisation of Science and Technology
b) Management / Administration
c) Finance d) Any others (Please specify)
05. Your strength in learning lies in ?
a) Do it yourself b) Reading and Writing
c) Seeing and hearing d) Any others (Please specify)
06. In what measure, do you prefer to concentrate more inside the galleries for understanding ?
a) Continuous b) Regular
c) Sporadic c) Any others (Please specify)
07. From the Chinese proverb, Which method do you prefer to understand the principle of working of the exhibit ?
a) Reading b) Seeing c) Doing
08. What mode of Environment do you experience in this Science Centre while going through the galleries ?
a) Under pressure due to constraint b) Noisy
c) Under relaxed condition d) In silence
09. Do you prefer to visit the Science Centre and acquire knowledge by coming?
a) Alone b) With family members
c) With your friends d) With your spouse (if married)
e) With your students (If you are a teacher)

10. Which kind of background do you expect to prevail in a Science Centre for learning ?
- Light background music
 - With people talking
 - Visitors enjoying with laughs and shouts
 - Working sound of the exhibits.
11. What is the comfortable sound you expect from this Science Centre for observing the exhibits ?
- Quite
 - Wavery sound
 - Far end sounds
 - Discussing sound
12. At what time you prefer to visit a Science centre for learning ?
- Morning (Before 12.00 Noon)
 - After lunch (13.00 to 15.00 hours)
 - Evening (After 16.00 Hours)
 - Any time
13. What /who motivated you to come and learn in this Science Centre ?
- Self realisation
 - Parents
 - Rewards expecting
 - Any others (please specify)
14. What is the methodology you expected at this Science Centre to exist, for learning ?
- Listening
 - Reading
 - Viewing
 - Experiencing
15. What type of structure of the exhibits is preferred by you ?
- Modular
 - Non-uniform
 - Any others (please specify)
16. How do you like to operate the exhibits ?
- Self operations
 - Demonstrations by experts
 - Just by observing in static mode
 - Any others (please specify)
17. What is your assessment of this Science Centre for learning in informal way ?
- Good
 - Above average
 - Satisfactory
 - Poor

Visitor's Signature

To
ER. R. MADHAVAN
 Joint Director (Electronics)
 Tamilnadu Science and Technology Centres
 Madras - 600 025.

Data
Table - 1

Questionnaire - III (Enclosed for reference)

Learning Styles - in Percentage Values

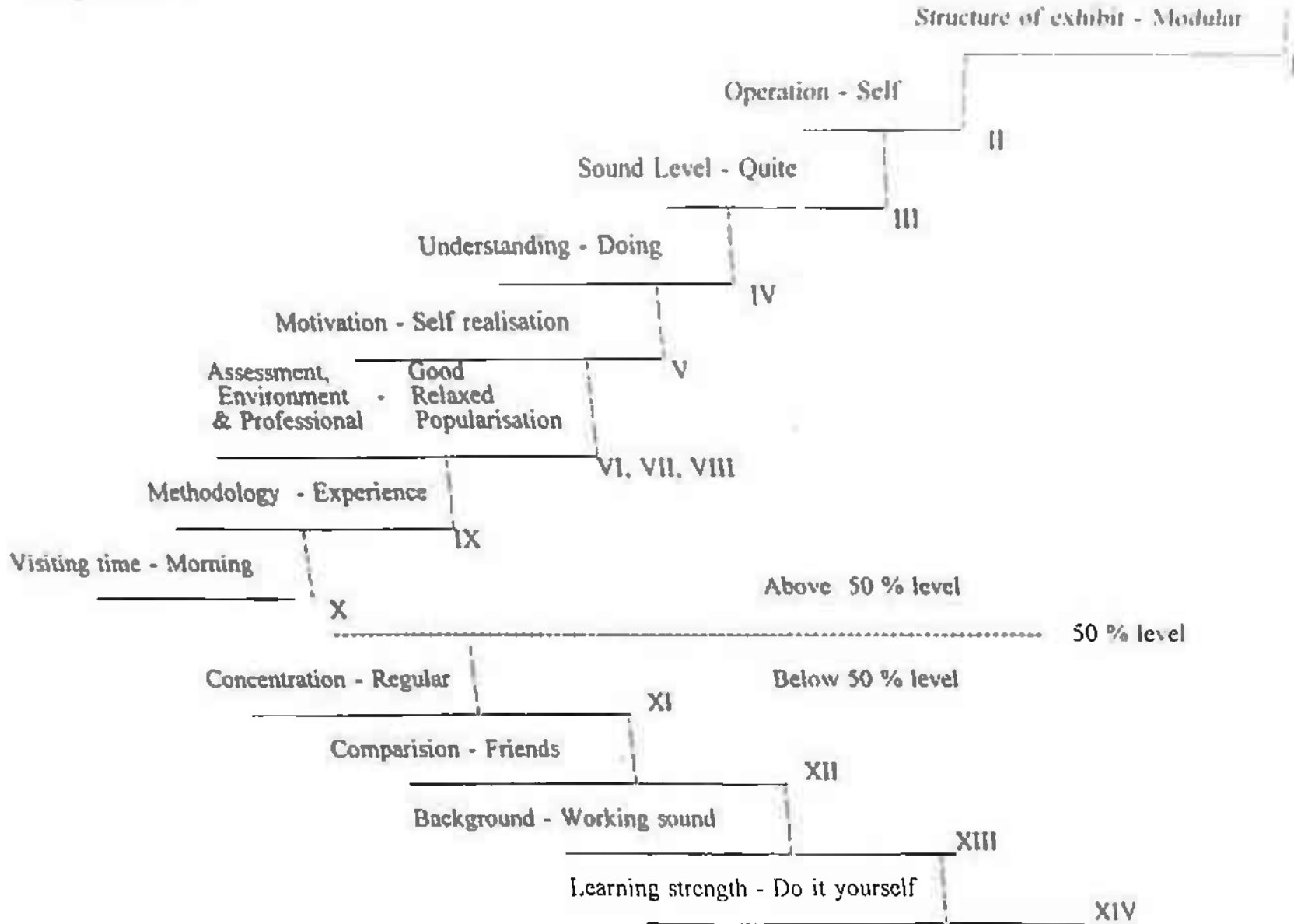
Q.No.	Category columns					Study Subject
	a	b	c	d	e	
04	52.5					
05	36.0	25	11.5	11	-	Professional level
06	32.0	27	32	5.0	-	Learning Strength
07	16.0	47	15			
08	08.0	22.0	62	-	-	Understanding
09	13.0	08.5	52.5	31.0	-	Environment
10	34.0	27	42	3.0	15	Companion
11	60.5	12.0	13	41	-	Background
12	50.5	5.5	14	20.0	-	Sound level
13	59.0	15.5	13	21.0	-	Preference
14	21.0	10.0	24	7	-	Motivation
15	69	11.0	17	51	-	Methodology
16	66	19	12	-	-	Structure
		24	8	2	-	Operation of Science Centre
17	52.5	8	37.5	2	-	Assessment of Science Centre

Table II

1. An ideal learner should have the following learning attitudes as the highest points.

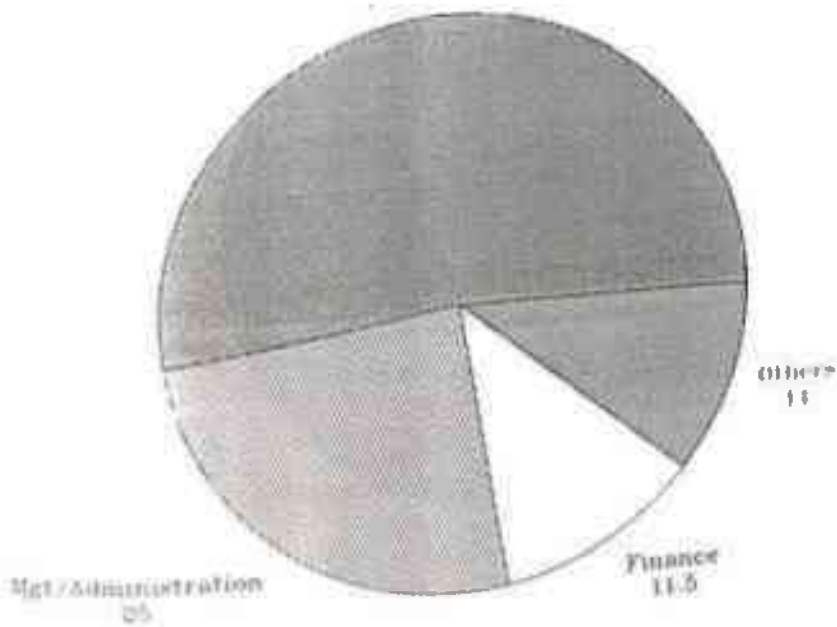
Sl.No	Attributes	Beliefs	Attitudes %	Ranks
1.	Structure	Modular	69%	1
2.	Operation of Science Exhibits	Self	66%	2
3.	Sound Level	Quite	60.5%	3
4.	Understanding	Doing	60%	4
5.	Motivation	Self-realisation	59.5%	5
6.	Environment	Relaxed	52.5%	7
7.	Professional level	Popularisation	52.5%	7
8.	Assessment of Science Centre	Good	51%	9
9.	Methodology	Experiencing	50.5%	10
10.	Visiting time Preference	Morning	47%	11
11.	Concentration	Regular	42.0%	12
12.	Comparison	Friends	41.0%	13
13.	Back ground	Working sound	36%	14
14.	Learning Strength	Do it yourself		

2. *Focus of the Questionnaire*
 Diagram No.1

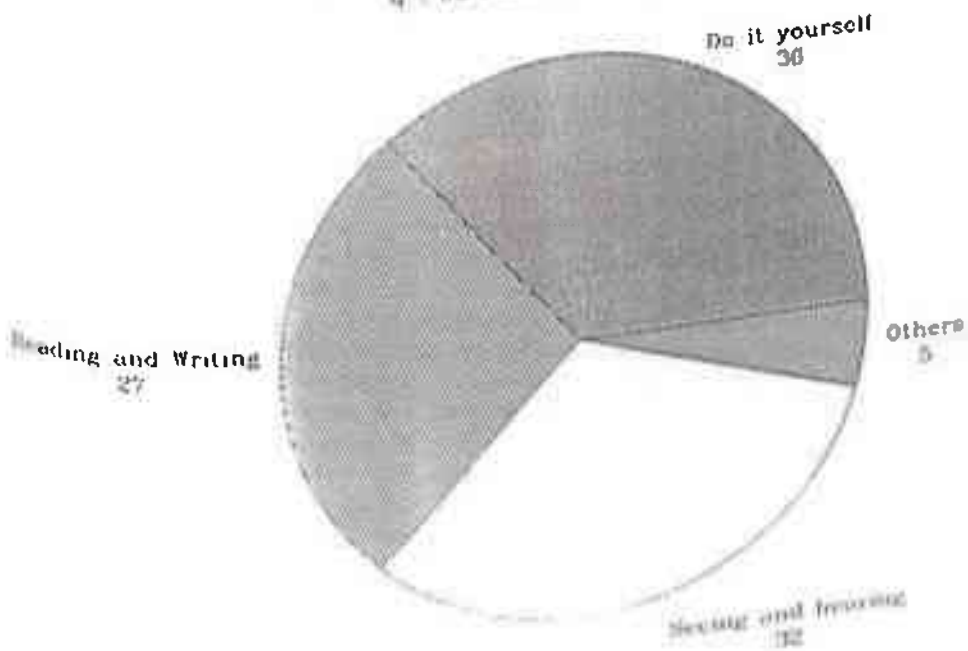


142

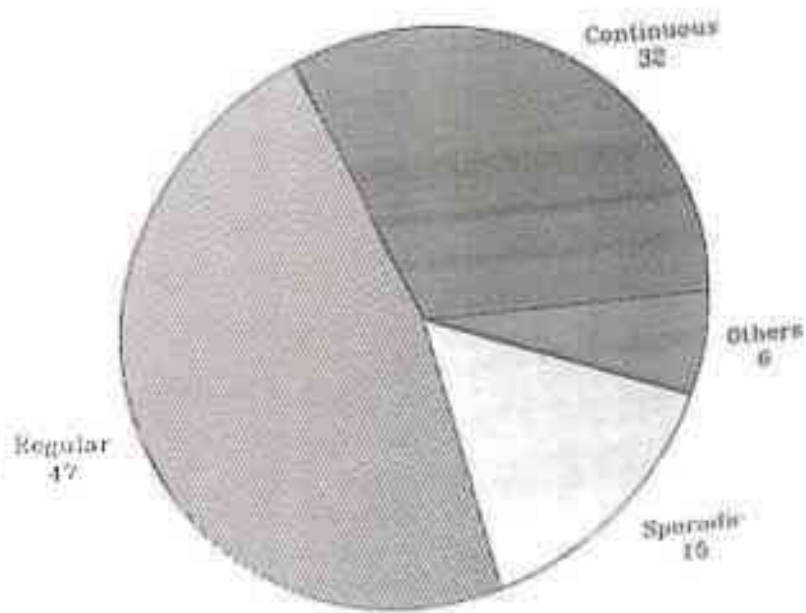
LEARNING STYLE QUESTIONNAIRE III
Q : 01 - PROFESSIONAL LEVEL
92.5 Popularisation



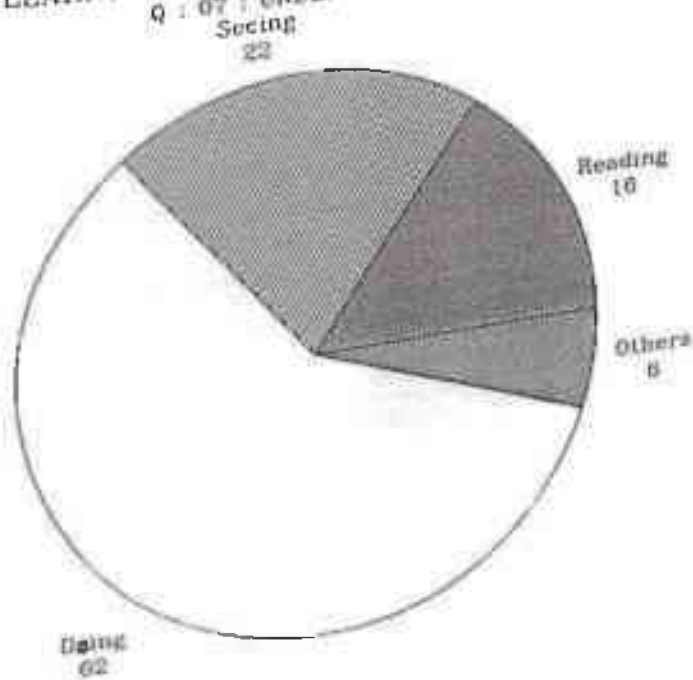
LEARNING STYLE QUESTIONNAIRE III
Q : 05 - LEARNING STRENGTH



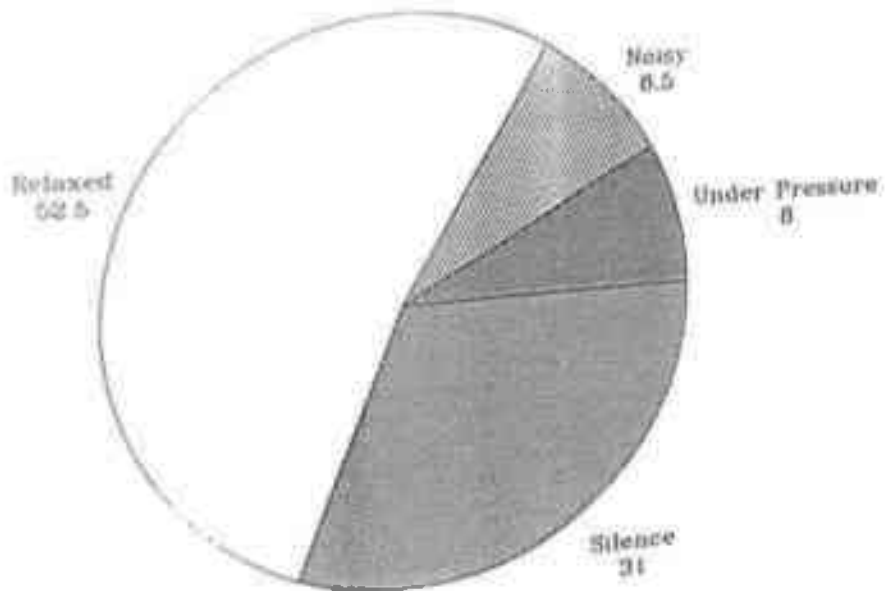
LEARNING STYLE QUESTIONNAIRE III
Q : 06 : CONCENTRATION



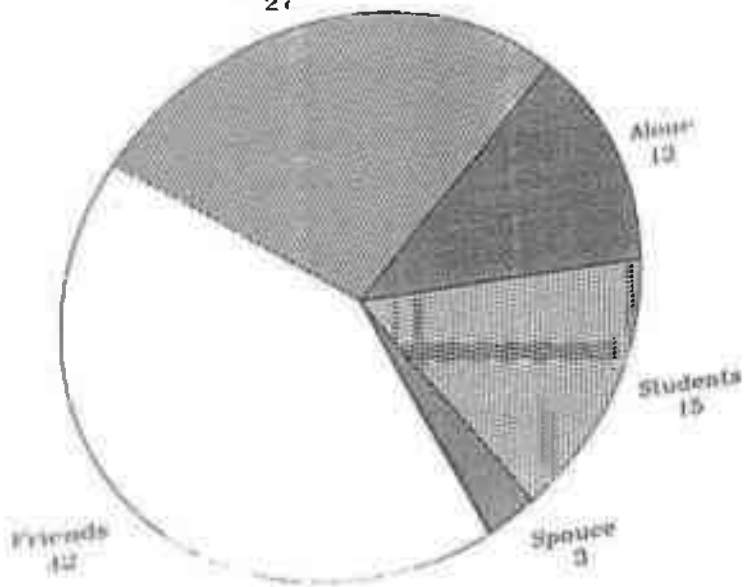
LEARNING STYLE QUESTIONNAIRE III
Q : 07 : UNDERSTANDING



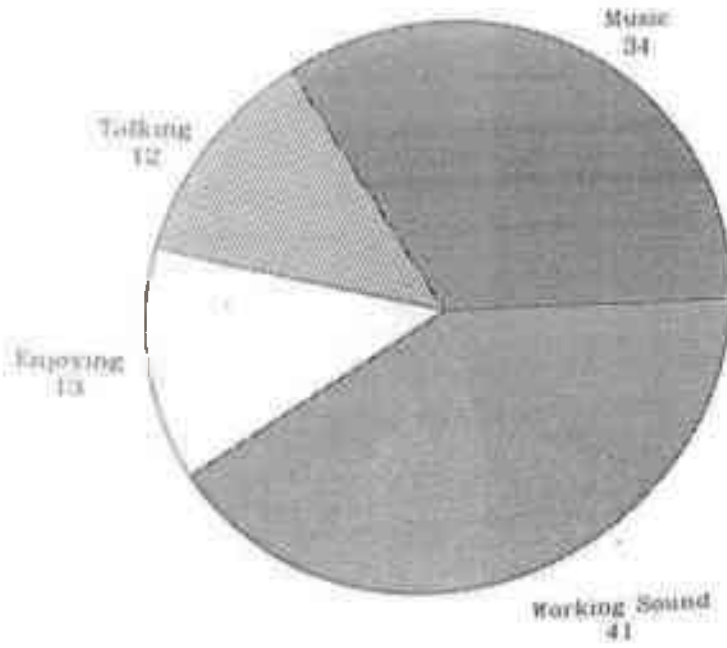
LEARNING STYLE QUESTIONNAIRE III
Q : 08 : ENVIRONMENT



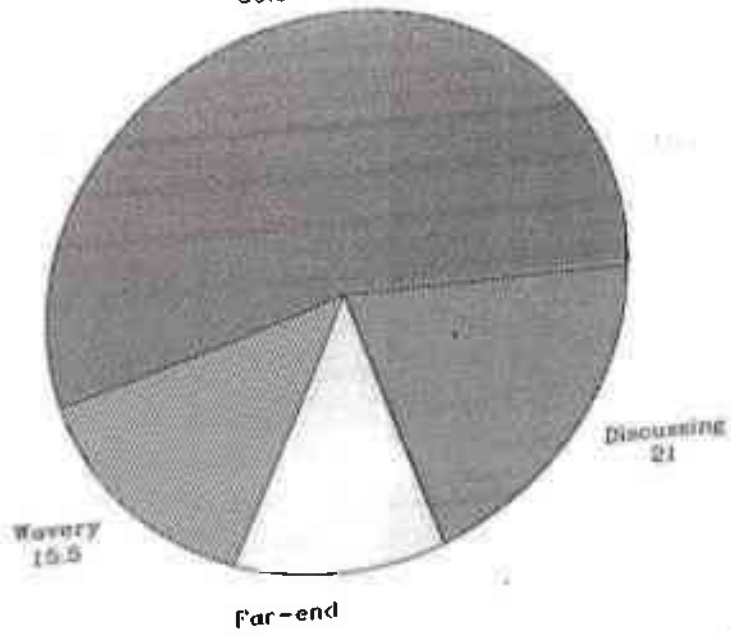
LEARNING STYLE QUESTIONNAIRE III
Q : 09 : COMPANION
Family
27



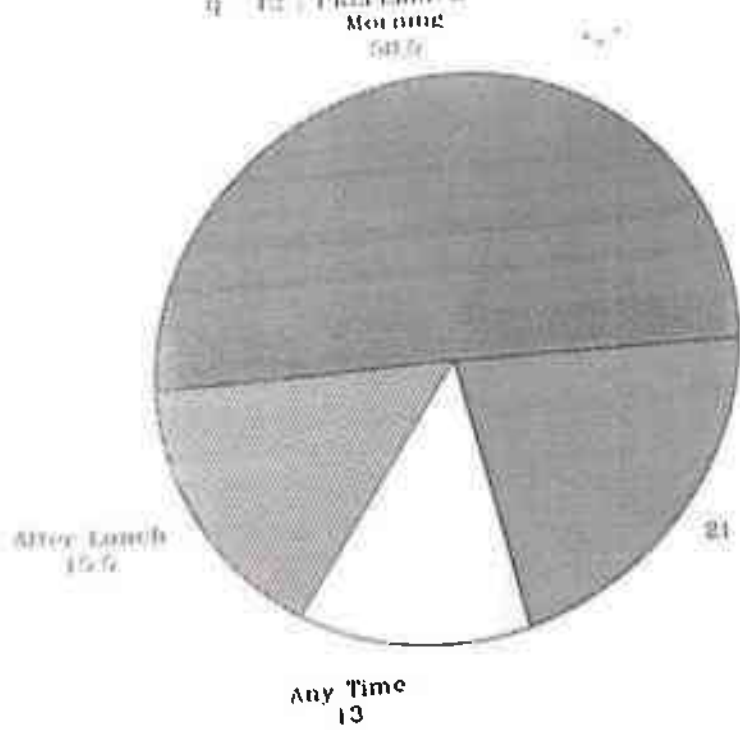
LEARNING STYLE QUESTIONNAIRE III
Q : 10 : BACKGROUND



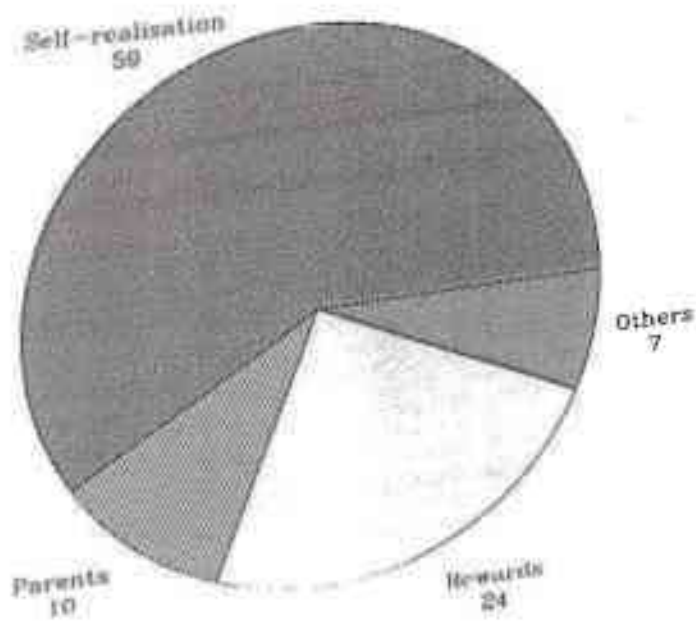
LEARNING STYLE QUESTIONNAIRE III
Q : 11 : SOUND LEVEL
Quite
60.5



LEARNING STYLE QUESTIONNAIRE III
Q : 12 : PREFERENCE OF VISITING TIME

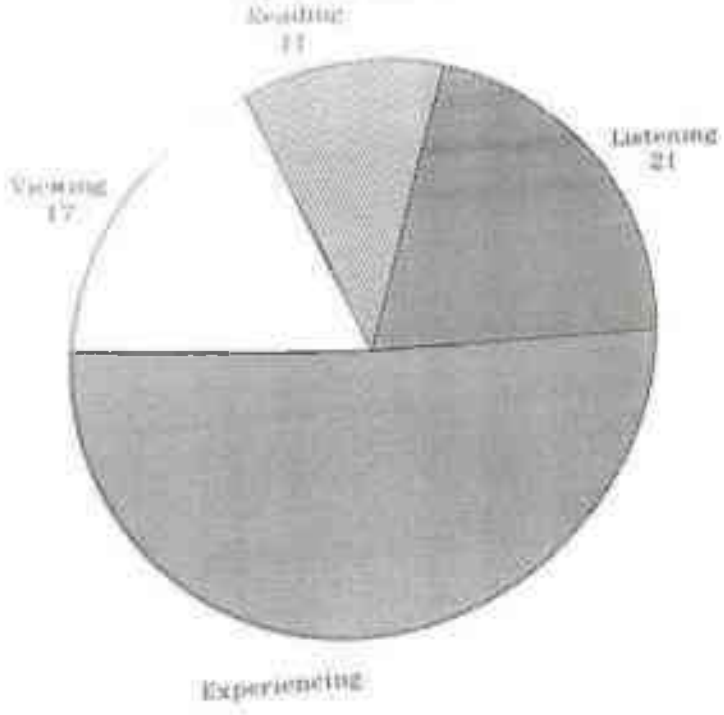


LEARNING STYLE QUESTIONNAIRE III
Q : 13 : MOTIVATION



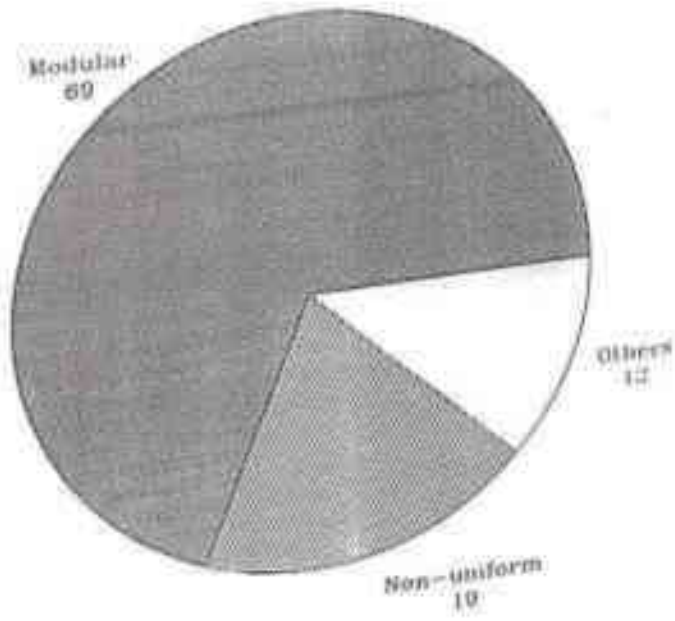
LEARNING STYLE QUESTIONNAIRE III

Q : 14 : METHODOLOGY

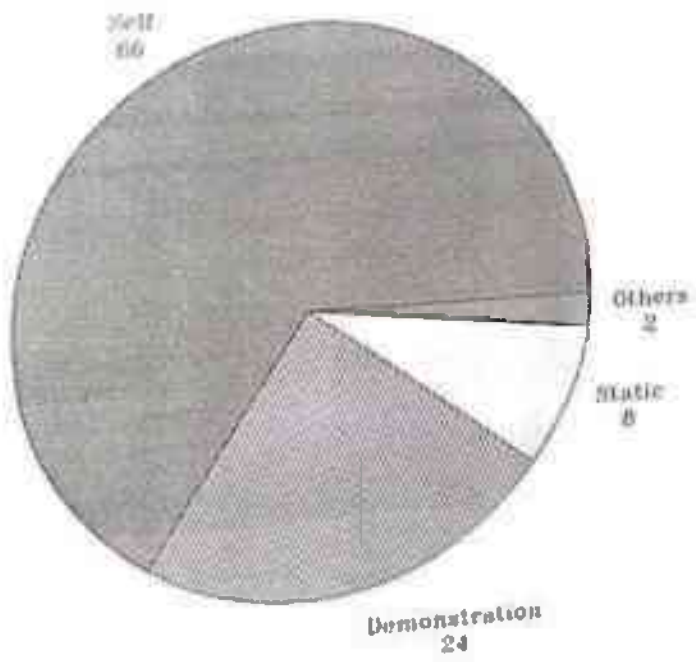


LEARNING STYLE QUESTIONNAIRE III

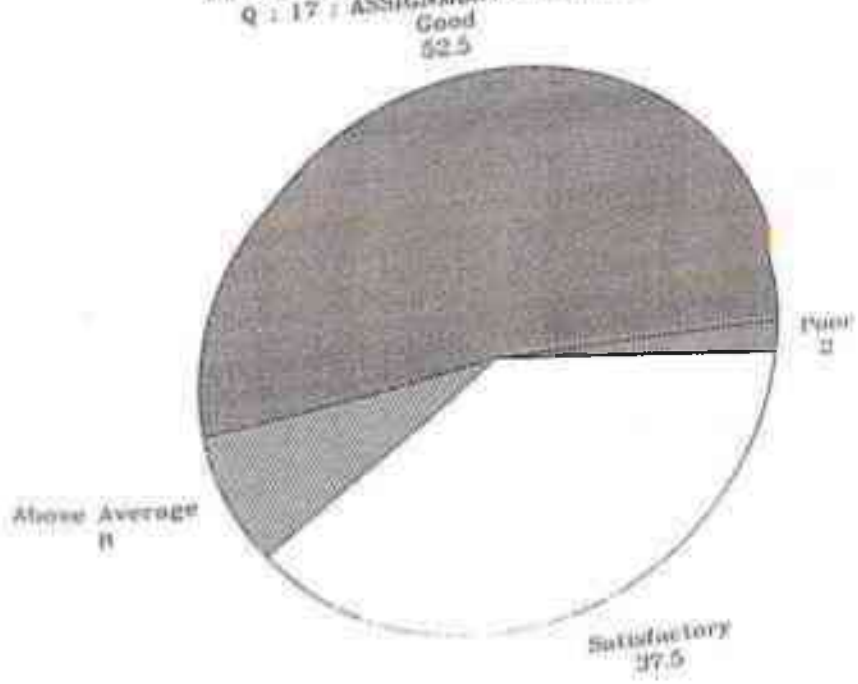
Q : 15 : STRUCTURE



LEARNING STYLE QUESTIONNAIRE III
Q. 16 : SCIENCE HABITS



LEARNING STYLE QUESTIONNAIRE III
Q. 17 : ASSIGNMENT OF SCIENCE CENTRE



Appendix No. 04

On

"Status of Science Centres"

1. Statistical Collection of various Science Centres in India and Abroad

1.1. National level Science Centres / Museums in India

- a. Birla Industrial Technological Museum (BITM), Calcutta.
- b. Visvesvaraya Industrial Technological Museum (VITM), Bangalore.
- c. Nehru Science Centre (NSC), Bombay.
- d. National Science Centre, Delhi.
- e. Birla Science Museum, Pilani, Rajasthan.
- f. Tamilnadu Science & Technology Centres, (IISRC) Madras.

1.2 Regional Science Centres :

- a. Shri Krishna Science Centre, Patna.
- b. Regional Science Centre (RSC), Lucknow, U.P.
- c. RSC Bhubaneswar, Orissa.
- d. Raman Science Centre, Nagpur, Maharashtra.
- e. Regional Science Centre, Bhopal, M.P.
- f. Regional Science Centre, Calicut, Kerala.
- g. Regional Science Centre, Tirupati, A.P.
- h. Regional Science Centre, Guahati, Assam.
- i. North Bengal Science Centre, Silguri, W.Bengal.

1.3 District Science Centre (DSC)

- a. DSC, Purulia, West Bengal.
- b. DSC, Gulbarga, Karnataka.
- c. DSC, Dharampur, Maharashtra.
- d. DSC, Tirunelveli, Tamilnadu.
- e. Science centre, Bardhaman, West Bengal.
- f. Sub-Regional Science Centre, Dhenkanal, Orissa.
- g. Science Centre, Digha, West Bengal.
- h. Sub Regional Science centre, Vijayawada.
- i. Tirupura Science centre, Agartala, Assam.

Science Centres / Museums in Abroad.

1.4 Deutsches Museum, Munich, Germany.

1.5 The Exploratorium, San Francisco, U.S.A.

1.6 The Museum of Science and Industry, Chicago, U.S.A.

1.7 The Franklin Institute Science Museum in Philadelphia, U.S.A.

1.8 The California Museum of Science and Industry, Los Angeles, U.S.A.

1.9 EXPLORA by the centre for Science and Industry at Lavillette, Paris.

1.10. Interactive Centres in the U.K.

1. All hands Gallery, London.
2. Archaeological Resource Centre, York.
3. Armagh planetarium, Northern Ireland.
4. Buxton Micrarium, Buxton.
5. Catalyst, Widnes.
6. Centre for Alternative Technology, Wales.
7. Curioxiety, Oxford.
8. Discovoery, Weymouth.
9. The Discovery centre, London.
10. Discovery Domes, London.
11. Earthquest, Northern Ireland.
12. Elsecar Heritage centre.
13. Eureka!, Halifax.

14. The Exploratory, Bristol.
15. Explore it, Northern Ireland.
16. Foredown Tower, East Sussex.
17. Greens mill and centre, Nottamgham.
18. Herstmonceux Science centre.
19. Inspire, Norwich
20. Intech, Winchester.
21. Jordrell Bank Science centre, cheshire.
22. Kaleidoscope, Milford Haven.
23. Launch pad and flight lab, London.
24. Light on Science, Birmingham.
25. National stone centre, Derbyshire.
26. Satrosphere, Aberdeen.
27. Science Factory, New castle
28. Science for life, London.
29. Scope, Sheffield.
30. Search, Hants.
31. Sella field visitor centre, Cumbria.
32. Ship shape, Liverpool.
33. Snibston discovery park, Leics.
34. Experiment!, Manchester.

2 - Data on Galleries of various centres in India :

2.1. Tamilnadu Science & Technology centres Madras.

- a. Transport
- b. Energy
- c. Materials Science
- d. Life Science
- e. Innovative
- f. Electronics & Communication
- g. Physical Science

2.2. Birla Industrial Technological Museum, Calcutta :

- a. Atom
- b. Motive power
- c. Transport
- d. Iron and steel, copper, petroleum
- e. Popular Science
- f. Electricity
- g. How things work.
- h. Television, Communication, Electronics
- i. Under ground coal mine.

2.3 Visvesvaraya Industrial and Technological Museum,
Bangalore:

- a. Electro - Technic
- b. Engine - Hall
- c. Timber, Paper and Metals in civilization
- d. Popular Science
- e. Children's Science

2.4 Nehru Science Centre, Bombay.

- a. Science for children
- b. Sound and Hearing
- c. Light and Sight
- d. Discoveries
- e. C.V.Raman
- f. Industry
- g. Our Heritage
- h. Evolution

2.5 National Science Centre, Delhi

- a. Heritage.
- b. Fun Science
- c. Information Revolution
- d. Prakash-Light
- e. Giant Energy Ball Exhibit
- f. Earth from space
- g. 25 years of space photography
- h. Computer Laboratories
- j. Children's Science Corner

2.6 Galleries in Regional Science Centres

1. Regional Science Centre, Patna

- a. Ocean
- b. Fun Science
- c. Popular Science Gallery
- d. Evolution
- e. Energy Ball Exhibit.

2. RSC, Lucknow
 - a. Aquamobile
 - b. Fluidics
 - c. Popular Science
 - d. Part of the Greenworld (Palaeo - botany)
 - e. Fish Gallery
 - f. Computer corner
 - g. Childrens' Science corner

3. RSC, Bhubaneswar, Orissa.
 - a. Sun Sustains life
 - b. Childrens' Science Corner
 - c. Computer Corner

4. RSC, Nagpur
 - a. The Umbrella
 - b. Fun Science
 - c. Childrens' activity corner
 - d. Computer corner

5. R,S,C., Bhopal
 - a. Invention I & II
 - b. Fun Science
 - c. Computer Corner
 - d. Childrens' activity corner
 - e. School Science Centre

6. RSC, Tirupati

- a. Motion
- b. Fun Science
- c. Childrens' Corner
- d. Creative Ability centre.
- e. A new childrens' Science galleries

7. RSC, Guwahati

- a. Earth Science
- b. Fun Science
- c. Agriculture
- d. Petroleum
- e. Forest
- f. Childrens, Science Corner
- g. Life Science Corner
- h. Mock-up coal mine
- j. Model School Science Centre

2.7 Galleries in District Science Centre

- 1. DSC, Purulia
- a. Wealth of purulia
- b. Popular Science
- c. Taramandal
- d. Childrens' Science Corner
- e. Computer corner
- f. Vibration

2. DSC, Gulbarga

- a. Wealth of Gulbarga
- b. Popular Science
- c. Childrens' Science corner
- d. Taramandal

3. DSC, Dharampur

- a. Popular Science
- b. Perception
- c. Taramandal
- d. Childrens' Science corner

4. DSC, Tirunelveli

- a. Treasures of the ocean
- b. Oceanic
- c. Popular Science
- d. Pet corner
- e. Children's play corner
- f. Taramandal
- g. Young scientist corner

5. SC, Bardhaman

- a. Popular Science
- b. Life Science
- c. Energy Ball
- d. Taramandal

3. Data on the Exhibits of the Galleries :

3.1 BITM, Calcutta

Highlights of exhibits :

Scale down model of blast furnace in the iron and steel galleries

Sustained oscillations

Dinosaur model

Glass is a bad conductor

Logic gate-tree

A working Robot

Flow chart on copper

An interactive exhibit on Himalayan Geology

An ice block exhibit to explain how the shivalinga of Amarnath is created.

A Travelling exhibition on the Himalayas.

A cut-section magnified view of human cell

An animated exhibit on the interior of the earth.

90-hands-on, participatory exhibits in rectification, oscillation, semi-conductor, digital electronics, micro-electronics, medical-electronics, computers and robotics.

An underground coal mine.

3.2 VITM, Bangalore

Highlights of the Exhibits:

1. Engine Hall - Steam power, water power, I.C. engines and a large energy Ball exhibit.
2. Electro technique
3. A working exhibit on bone
4. Robotics
5. An exhibit on the Ellipse.
6. Exhibits on "Motion"
7. Van de craft generator
8. An exhibit on pythagorus theorem
9. Dinosaurs
10. On "Gears"

3.3 Nehru Science Centre, Bombay

Highlights of exhibits :

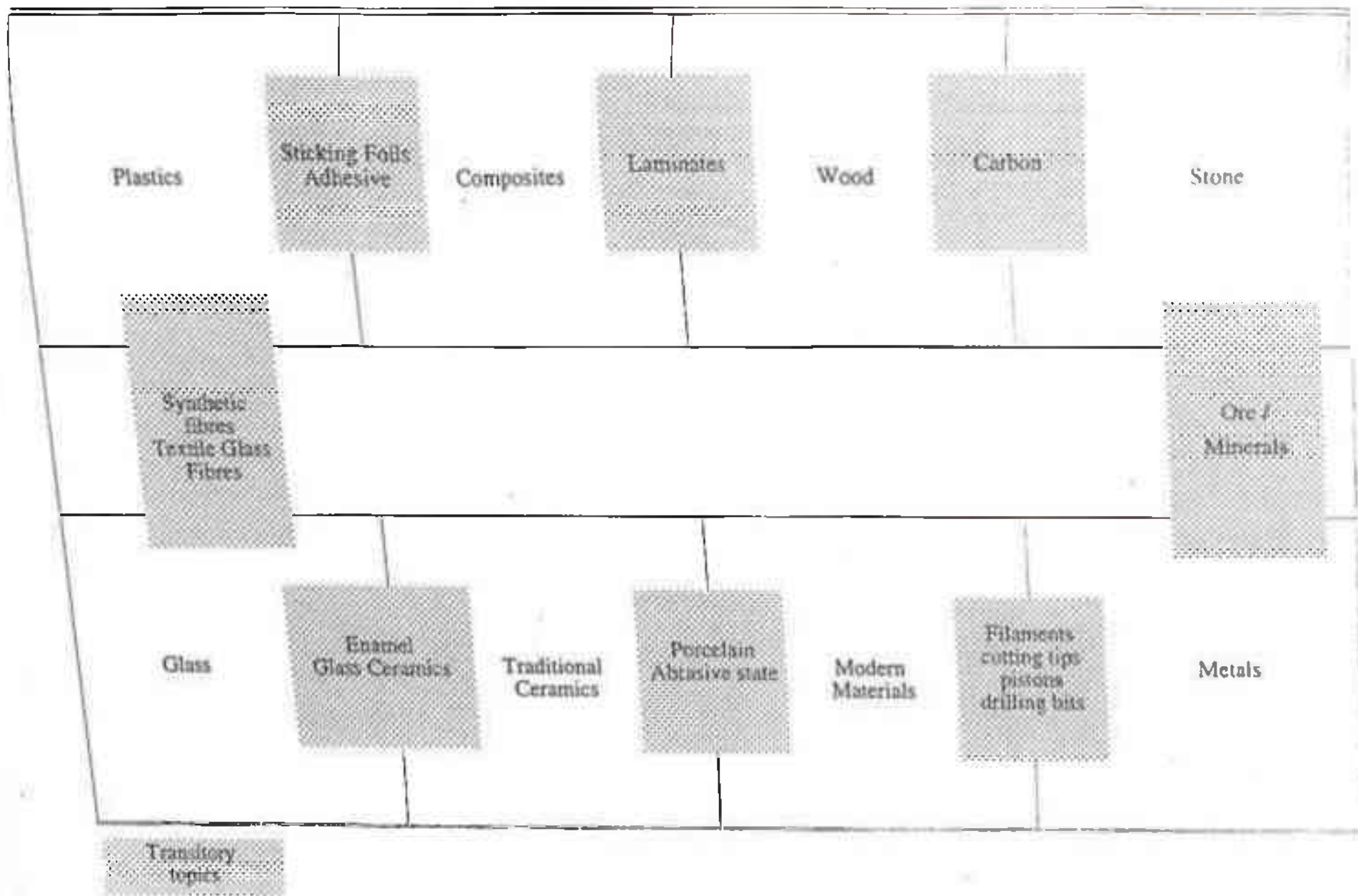
1. Magnifier for Science for children - a new participative exhibit
2. Rocketry programme:- demonstrative type.
3. Man- machine-galleries.
4. Weather Station - for children.
5. Light exhibits - like working functions of 'EAR', speed of sound, sound transmission, Echo effects etc.

Appendix No. 05

On

"Materials Science"

Materials Science Gallery



Main Topics

1. Plastics is a man-made and the most widespread materials of our times; they are a part of our day-to-day-lives and widely applied in different fields of modern technology and engineering.
2. Plastics are used for household products such as bottles, containers and drinking tumblers and dishes, for toys, for medical purposes (e.g. capsules, disposable syringes), for transport and packing purposes, for safety devices such as a helmet as well as for constructional purposes in vehicles.
3. Plastics are organic materials which are structured as macromolecules. They are the result of the transformation of natural products or of the synthesis of primary substances such as crude oil and natural gas which are the raw materials. The synthesis starts with monomers = small molecules and leads to macromolecules.
4. The mostly used manufacturing processes of plastics are: Extrusion, Intrusion, Injection, Blowing, Deep Drawing, Powder Coating, Fluidized bed sintering.

Objects - Media**Hands-on-Experiment Flexibility by heat**

Two rods - one made from duroplastic and one made from thermoplastic - are in a pot heated by hot air 130°C. The visitor switch on the experiment. Both rods are lifted and turned horizontally. He can recognize, that the thermoplast rod bends, while the duroplast does not bend.

Interactive wall

See 6.1.3 Manufacturing / Processing

Photographs

Four or five pictures showing the bad sides of plastics: environmental pollution

Multimedia Plastics and Composites

1. The visitor can identify Plastics objects in a car by pressing on the right things on the Touch screen - See 6.1.2 / 3

Spatial Units

- Plastics 6.0.1 a: Hands-on-Experiment Flexibility by heat with an information flip
- Plastics 6.0.1 b: Interactive wall - See 6.1.3 Manufacturing / Processing
- Plastics 6.0.1 c: Photographs with a text label
- Plastics 6.0.1 d: Multimedia Plastics and Composites

Remarks

Main Topics

1. Normal properties: Plastics are strong.
2. We differ between thermoplastics (meltable, soluble, flexible) and duroplastics (non meltable, non soluble and stable).
3. Following surprising properties: Heating a rubber ribbon means shortening the ribbon.

Objects - Media

Hands-on-Experiment showing strength of plastics

A plastic rope with an impressing object (e. g. hammer, tool) can be lifted by the visitor (around 50 cm height). He can release the object that is falling on plastic a helmet. The helmet resists to the falling objects.

Hands-on-Experiment chemical resistance see 4.2.1 Transit Topic Enamel (comparison with other materials)

Hands-on-Experiment shortening rubber by heat

A rubber ribbon with a weight (around 500 g) is put on a pan of a balance with digital indication. The visitor switches on IR-light (about 10 s). The ribbon is heated and shrinks itself. Thus the weight becomes less (several g). Switching off the IR-light, the shrinking restores back to original length and weight (necessary time more than 30 s).

Spatial Units

Plastics 6.1.1 a: Hands-on-Experiment showing strength of plastics with an information flip
 Plastics 6.1.1 b: Hands-on-Experiment shortening rubber by heat

Remarks

Main Topics

1. Small molecules with double bonds are linked together by radical producing agents (peroxides). Thus a macromolecule is created.
2. The macromolecules have completely different qualities than the monomers.

Objects - Media

Multimedia Plastics and Composites

1. Showing the procedures during the polymerisation (animation + eventually comics). For creating a more interactive system the visitor can select from a menu the appropriate chemical agents for polymerisation. If he is right the polymerisation starts, showing the different type of macromolecules as animation.

Spatial Units

Plastics 6.1.2 a: Multimedia-Station (Combine with the Videos and Multimedia of 6.1.1/3)

Remarks

Main Topics

1. Plastics are processed
 - by extrusion (e. g. tubes, bottles, rods)
 - deep drawing (masks, plastic containers)
 - screw injection molding (logo of DM, caps of bottles)
 - powder coating by high frequency (metal objects, toys, cars - plastic powder blown by air pressure from a pistol is charged positive, the metal object is charged negative. The positive powder is attracted and deposited on the surface of the object. Heating up to 150 - 200 °C the coat ist solidified)
 - fluidized sintering (immerse an object in a plastic fluidized bed formed by air pressure; the plastic melts on the surface of the object und spreads uniformly throughout the object - irregular objects can be coated easily).

Objects - Media

Originals

- Plastic injection moulding machine (Ahrburg from the gallery of Building Blocks in the Deutsches Museum)
- Deep drawing machine (vacuum pump, heating system - ABS-Material = copolymerisate Acrylnitrile butadiene styrene, special PVC)
- Interactive wall of plastic products
- Showing the most important and impressive products in an interactive way - see Multimedia Plastics and Composites

Multimedia Plastics and Composites

1. Showing manufacturing processes as videos
2. The visitor can identify the kinds of plastics on a wall which is depicted on the surface of the touch screen. For making the game more interesting we can give a time target (maybe 30 seconds) for recognizing the plastics) - See 6.0.1 / 6.1.2

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Spatial Units

- Plastics 6.1.3 a: Original Plastic injection molding machine and a text label
- Plastics 6.1.3 b: Original Deep drawing machine and a text label
- Plastics 6.1.3 c: Interactive wall of plastic products combined with the multimedia
- Plastics 6.1.3 d: Multimedia Plastics and Composites

Remarks

Main Topics

1. Plastics are constitutive elements of composites, especially as sticking part.
The most import combinations are:
 - glass fibers reinforced plastics (e. g. polyester)
 - carbon fibers reinforced plastics
 - laminated glass by using adhesive foils as reinforcing elements.
2. Laminated safety glass-made up of at least two plates of glass bonded by an interlayer of plastics.
When this type of glass cracks or breaks, the adhesive layer keeps the splinters from shattering.

Objects - Media

Original bench of laminated glass

The visitor can see the different layers when sitting on the bench

Photographs

The use of laminated glass, such as windscreen of a car, bullet proof glass in banks or in safety cars

Spatial Units

Plastics 6.2.1 a: Original bench of laminated glass with an information slip

Plastics 6.2.1 b: Photographs with text labels (combined with the bench)

Remarks

Main Topics

1. Nylon is built by a chemical reaction.

Objects - Media

Demonstration Nylon rope trick (every day maintainance needed, costly)
 Sebacinacidichloride (20 ml is solved in 400 ml Tetrachloromethane and
 1,6-Hexanediammine in water (400 ml, 1%) with phenylphthalcine for indication (one drop
 only). Put the tetrachloromethane in a beaker (800 ml); pour carefully the water solution on
 top. On the contact surface Nylon is built. Pick the skin with a pincer, draw it up to the
 slowly rotating roller and wind it. The quantity is enough for one day.

Photographs

Use of cut glass fibers with the plastics and the production.

Spatial Units

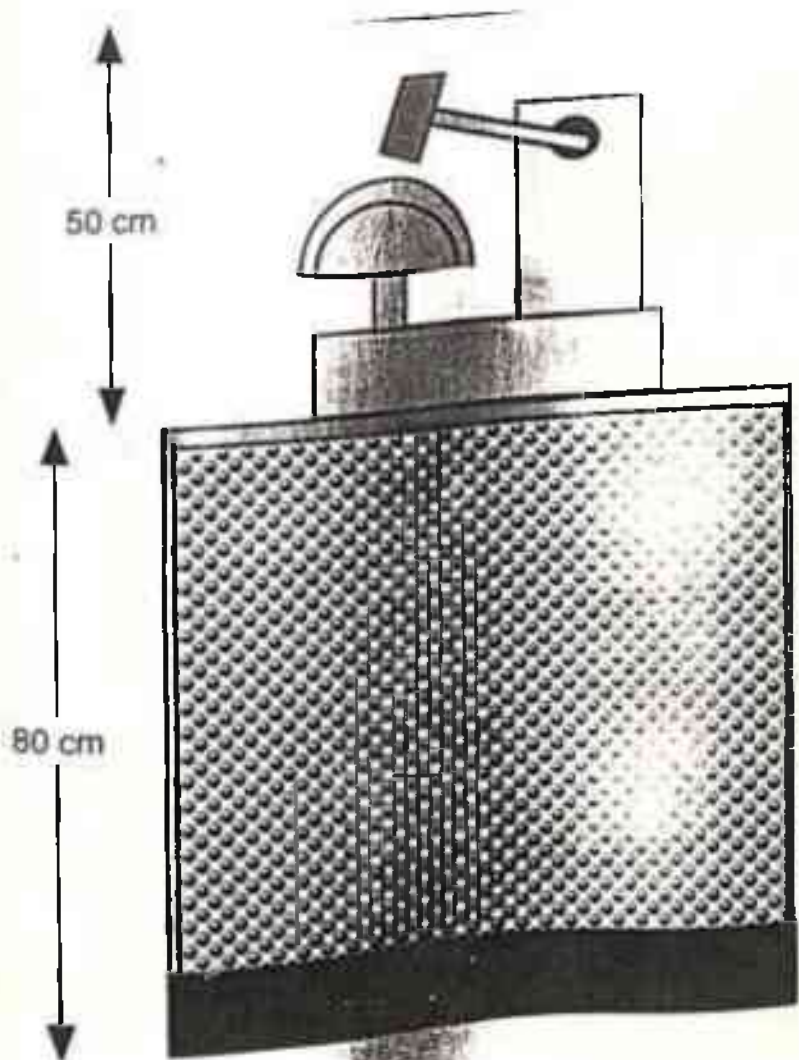
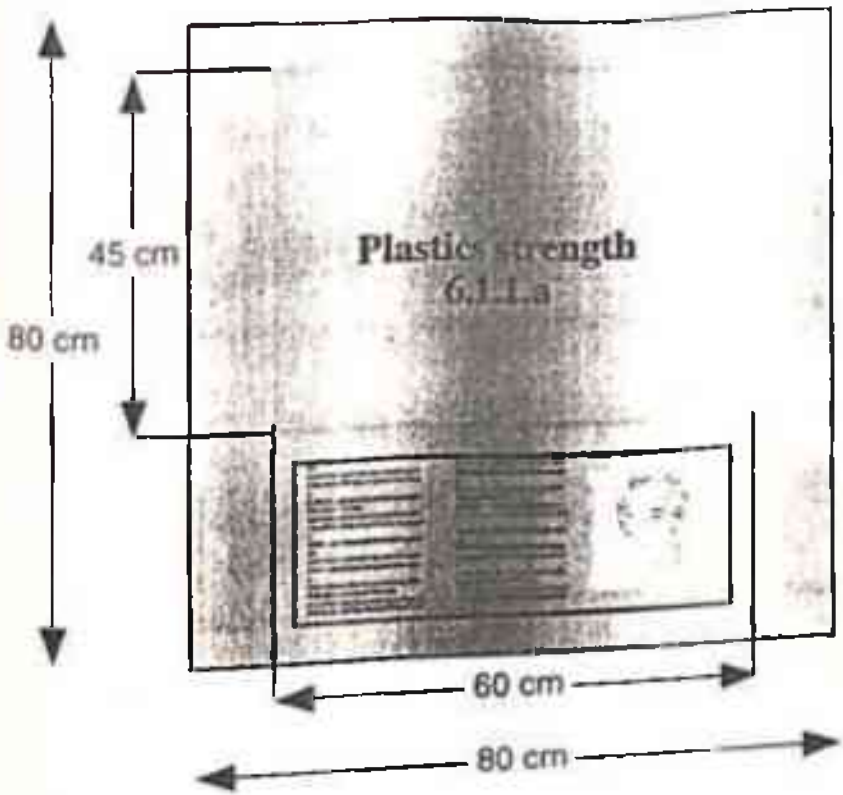
Plastics 6.2.2 a: Demonstration Nylon rope trick with an information flip
 Plastics 6.2.2 b: Photographs with a text label

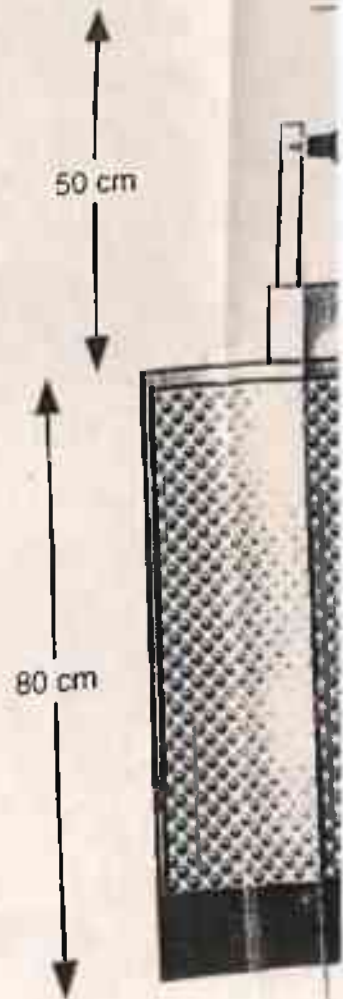
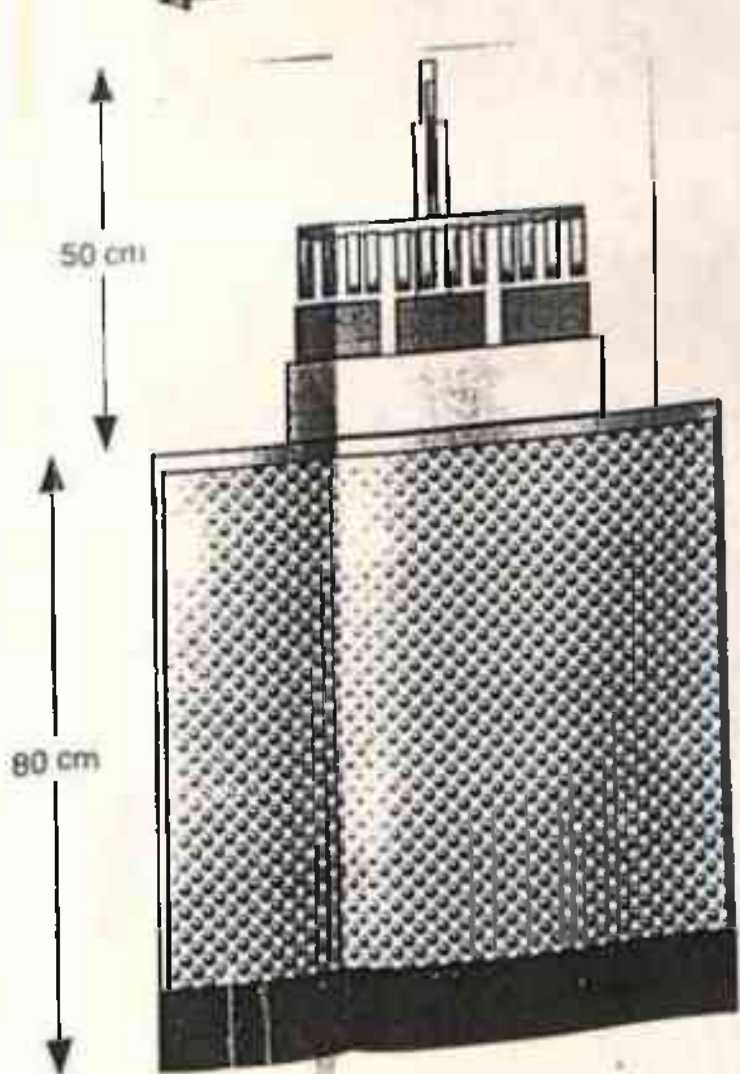
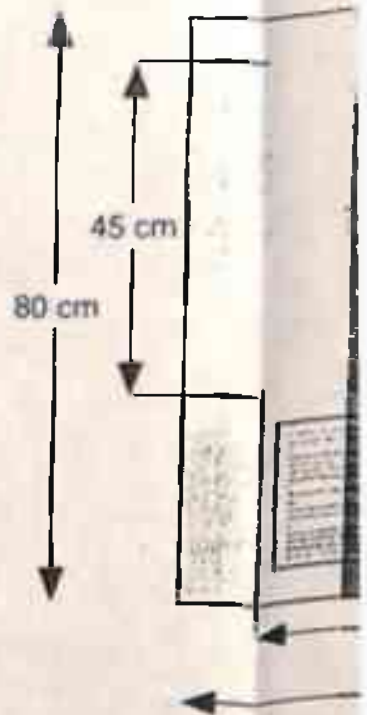
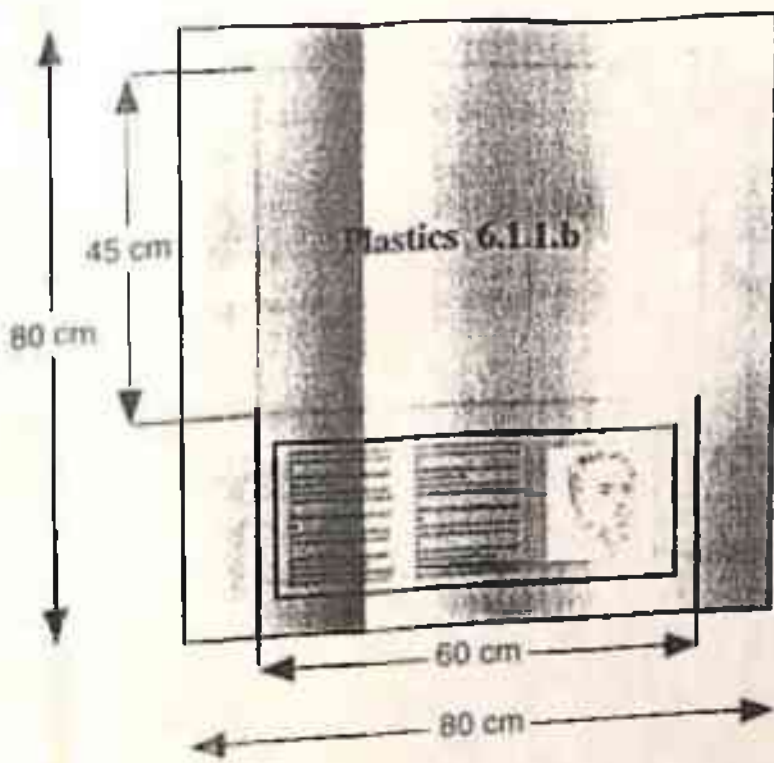
Remarks

A Nylon making unit is costly and every day changing and adding solvents -maintenance will be
 required. It should be handled carefully.

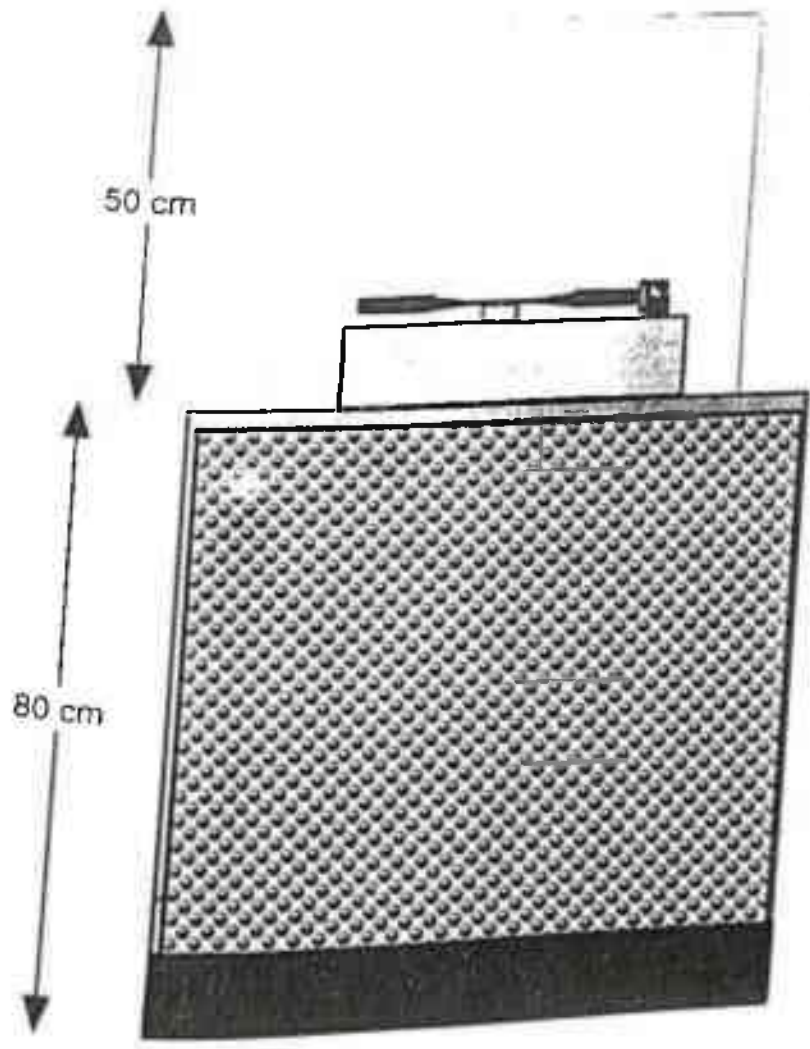
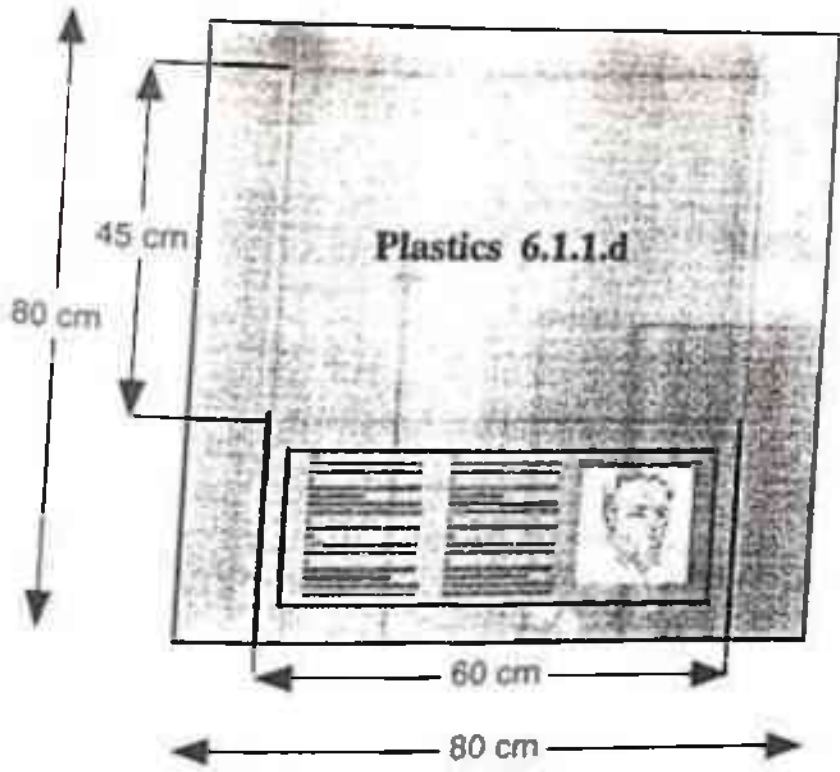
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Tamilnadu Science and Technology Centre
Plastics Properties and structure
Groundplan/ Frontview
20.2.96

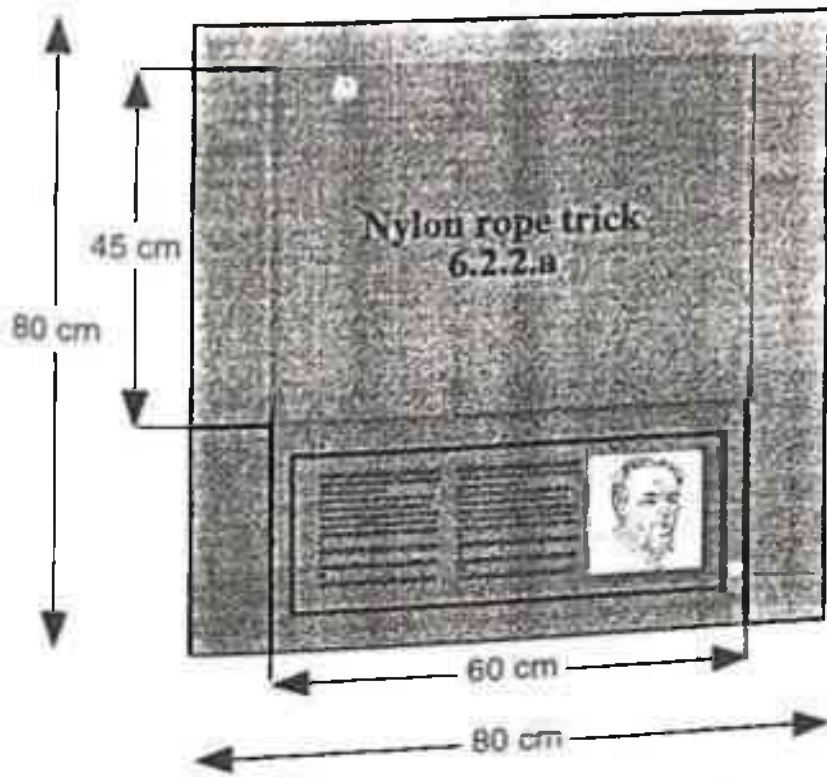




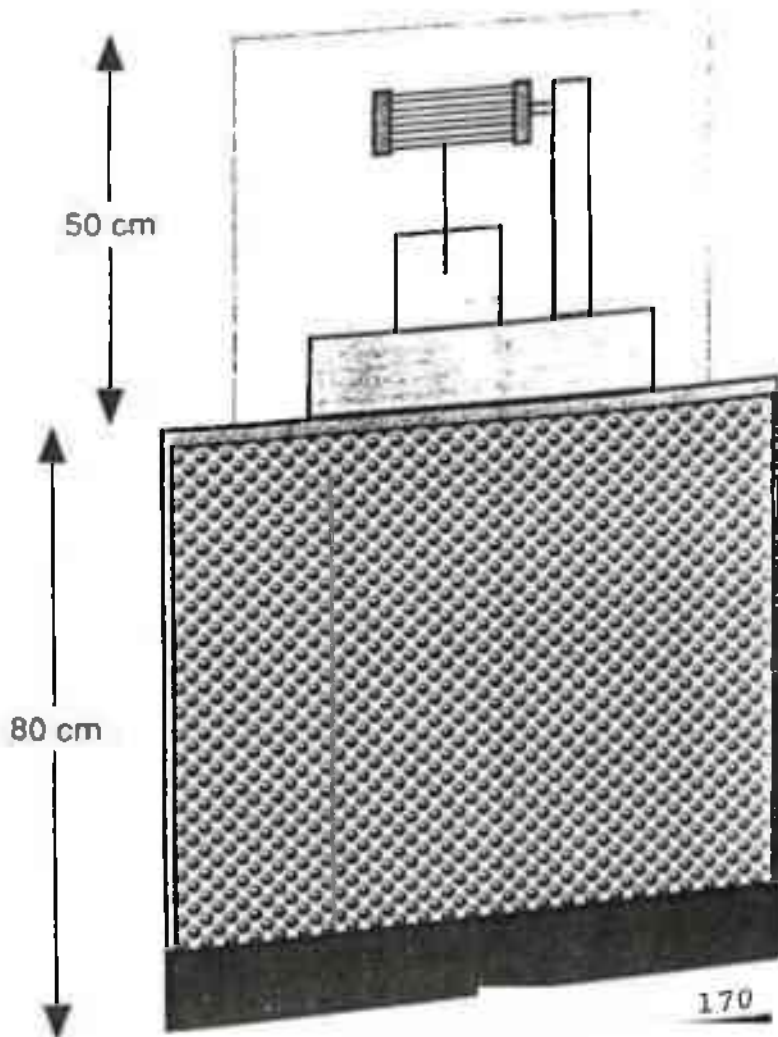
Tamilnadu Science and Technology Centre
Plastics Properties and structure
Groundplan/Frontview
20.2.96



Tamilnadu Science and Technology Centre
Plastics Transit Topic-Glass
Groundplan
20.2.96



Pict and text
6.2.2.b

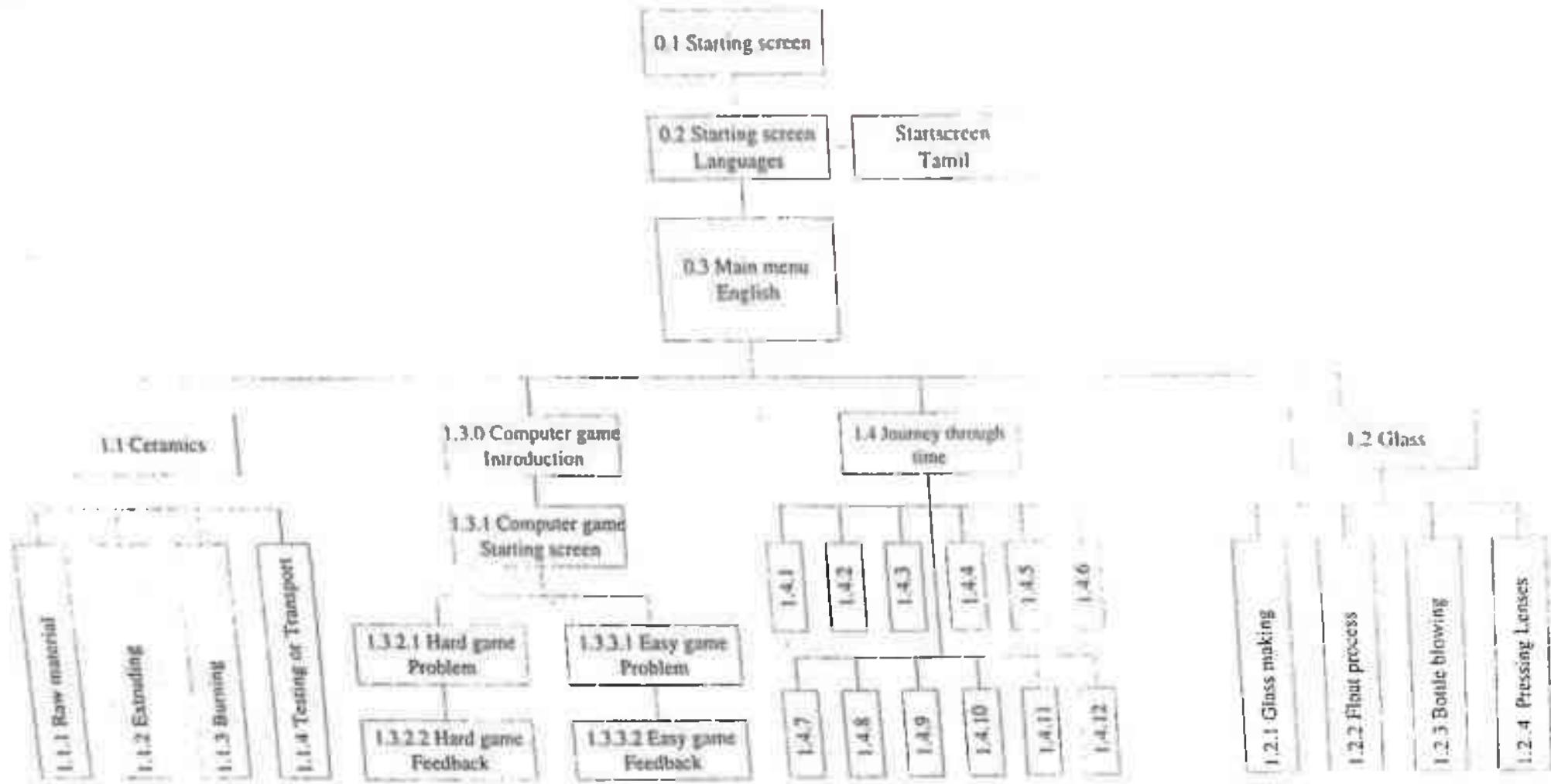


Appendix No. 06

On

"Multimedia Ceramics & Glass"

Matrix



Data files

Section 0 Introduction Subgroup

Groups 0.1 Starting screen Elements

Title Protection of the screen and motivation of the visitors 02.03.

Audio Text
 Some proposals
 - leading figure such as Mickey mouse which differs from station to station
 - text label, such as "touch me" zooming in and out or collapsing of the text
 - small video sequences

Written Text

Pictures / Text media
 Still to decide

Videos / Audios
 Still to decide

Graphics / Animations
 Animation developed by the software producer

Further Media

Remarks concerning topics and media
 Necessary is a common element for the Multimedia System which is similar at every screen.

Button for operations 1	Button for operations 2	Button for operations 3	Activities / ways By touch to 0.2
Remarks for the software			Links 0.2
			Number of branches one

Section	0 Introduction	Subgroup	
Groups	0.2 Starting screen Languages	Elements	
Title	Languages		02.03

Audio Text

Welcome to the Materials Science Gallery. At this station you can get information about Ceramics and Glass. Enjoy your stay and the Multimedia Information.

Written Text

Choose the language / Moūshi therivi

Pictures / Text media

Still to decide

Videos / Audios

Still to decide

Graphics / Animations

Animation developed by the software producer

Further Media

Remarks concerning topics and media

The visitor can select here the language he prefers; he decide between English and Tamil. At the right side of the written texts there should be a button for every language. After the selection the visitor should be addressed in the chosen language.

Button for operations 1 Button for operations 2 Button for operations 3 Activities / wars
Automatically to the next screen
0.3

Remarks for the software
After a defined time the System should return to the starting screen (0.1).

Links
0.3
Number of branches
one

Section 0 Introduction

Subgroup

Groups 0.3 Main menu

Elements

Title Main menu

02.03.

Audio Text

Ceramics (a) is the oldest synthetic material used by the people.
 Glass (b) is a crystal clear, fractile and transparent material.
 At this station you can get information dealing with modern processes.
 What do you prefer: Ceramics or Glass?
 Maybe you are interested in a computer game
 or in a journey through time.
 Make your decision!

Written Text

Ceramics
 Glass
 Computer game
 Journey through time

Videos / Audios

Pictures / Text media

- a. Photograph of a Ceramics process
- b. Photograph of a Glass process
- c. Photograph of a child playing with the computer
- d. Photograph of a historical glassmaker or on Ceramics maker

Further Media

Graphics / Animations

Animation : The picture for a Ceramics process is approaching from behind to the screen and is going back beside the Text label "Ceramics" which appears. This procedure must be finished after the first sentence.
 It is all the same with the glass, Computer game and Journey through time.

Remarks concerning topics and media

The position of the small letters a. and b. marks of the appearance of the corresponding picture.
 When the speech is finished the visitor can select what he prefers by touching Ceramics, Glass, Computer game and Journey through time.

Button for operations 1	Button for operations 2	Button for operations 3	Activities / ways
			By touch to the next screens 1.1 until 1.4
Remarks for the software			Links
After a defined time the System should return to the starting screen (0.1)			1.1, 1.2, 1.3, 1.4
			Number of branches
			four

Section	I INFORMATION	Subgroup	
Groups	1.1 Ceramics	Elements	
Title	Ceramics Introduction		02.03

Audio Text

After the settlement, people used to eat cooked food (a); thus they needed dishes resistant to heat (b) often available near the living places was the material for making ceramics dishes. It could be formed easily (c) to any desired shapes and sizes. After drying and burning (d) the dishes have become strong and resistant to heat and food. Bricks (e) on bricks (d), tiles, slabs and tubes (e) were produced. Ceramics was also used by the artists (f) for creating works of art. Ceramics was applied to insulators (g) because of its bad conductivity. If interested in modern processes make your decision.

Raw material
Extruding bricks
Burning
Testing / Transportation

Written Text

Raw material (h)
Extruding bricks (i)
Burning (j)
Testing / Transportation (k)

Pictures / Text media

a. Picture of people from the stone age eating cooked food in
ceramics pots, b. Photograph of clay mining; c. Photograph of
a potting rotor; d. Photograph of bricks; e. Photograph of
slabs; f. Photograph of an artifact; g. Photograph of an large
insulator, h. Photograph of raw material; i. Photograph dealing
with extruding bricks; j. Photograph dealing with burning; k.
Photograph dealing with testing / transportation

Videos / Audios

Alternative to c.: Video sequence of a craftsman using a potting rotor

Graphics / Animations

Animation: The pictures h. to k. are going aside the
corresponding text labels so that you have of four pictures in
one row and the text labels below.

Further Media

Remarks concerning topics and media

The position of the small letters a. and b. marks of the appearance of the corresponding picture.

When the speech is finished the visitor can select what he prefers by touching raw material, extruding bricks, burning, testing / transportation

Button for operations 1	Button for operations 2	Button for operations 3	Activities / ways
Main Menu			By touch to the next screens 1.1.1 to 1.1.4
Remarks for the software			Links
When a defined time the System should return to the starting screen (0.1).			1.1.1 to 1.1.4; 0.3
			Number of branches
			five

Tamil Nadu Science and Technology Centre Station Ceramics / Glass

Section I INFORMATION Subgroup I.1.1 Raw material / Video

Groups I.1 Ceramics Elements

Title Ceramics Raw material / Video 02.03

Audio Text

In the video the audio message will be available. Maybe the text must be written by the curator.

Written Text

Pictures / Text media

Videos / Audios

Video sequence of raw material (Duration: < 2 minutes)

Graphics / Animations

Further Media

Remarks concerning topics and media

The video runs automatically.

Button for operations 1	Button for operations 2	Button for operations 3	Activities / ways Automatic transit I.1
Main Menu			
Remarks for the software After a defined time the System should return to the starting screen (0.1).			Links I1: 0.3 Number of branches two

Section **1** INFORMATION

Subgroup **1.1.2** Extruding / Video

Groups **1.1** Ceramics

Elements

Title **Ceramics Extruding / Video**

02.03

Audio Text

In the video the audio message will be available. Maybe the text must be written by the curator.

Written Text

Pictures / Text media

Videos / Audios

Video sequence of raw material (Duration: < 2 minutes)

Graphics / Animations

Further Media

Remarks concerning topics and media

The video runs automatically.

Button for operations 1	Button for operations 2	Button for operations 3	Activities / views
Main Menu			Automatic transit 1.1
Remarks for the software			Links
After a defined time the System should return to the starting screen (0.1).			1.1: 0.3
			Number of branches
			two

Section: INFORMATION

Groups: I / Ceramics

Subgroup: I.1.3 Burning / Video

Title: Ceramics Burning / Video

Elements:

02.03

Audio-Text
 In the video the audio message will be available. Maybe the text must be written by the curator.

Written Text

Pictures / Text media

Videos / Audios

Video sequence of raw material (Duration: < 2 minutes)

Graphics / Animations

Further Media

Remarks concerning topics and media

The video runs automatically.

Button for operations 1. Button for operations 2. Button for operations 3. Activities / ways:

Main Menu

Automatical transit 1.1

Remarks for the software

After a defined time the System should return to the starting screen (0.1).

Links

I.1; 0.3

Number of branches

two

Section I INFORMATION Subgroup 1.1.4 Testing / Transportation / Video

Groups I 1 Ceramics Elements

Title Ceramics Testing / Transportation / Video 02.03

Audio Text
 In the video the audio message will be available. Maybe the text must be written by the curator.

Written Text

Pictures / Text media

Videos / Audios
 Video sequence of raw material (Duration: < 2 minutes)

Graphics / Animations

Further Media

Remarks concerning topics and media
 The video runs automatically.

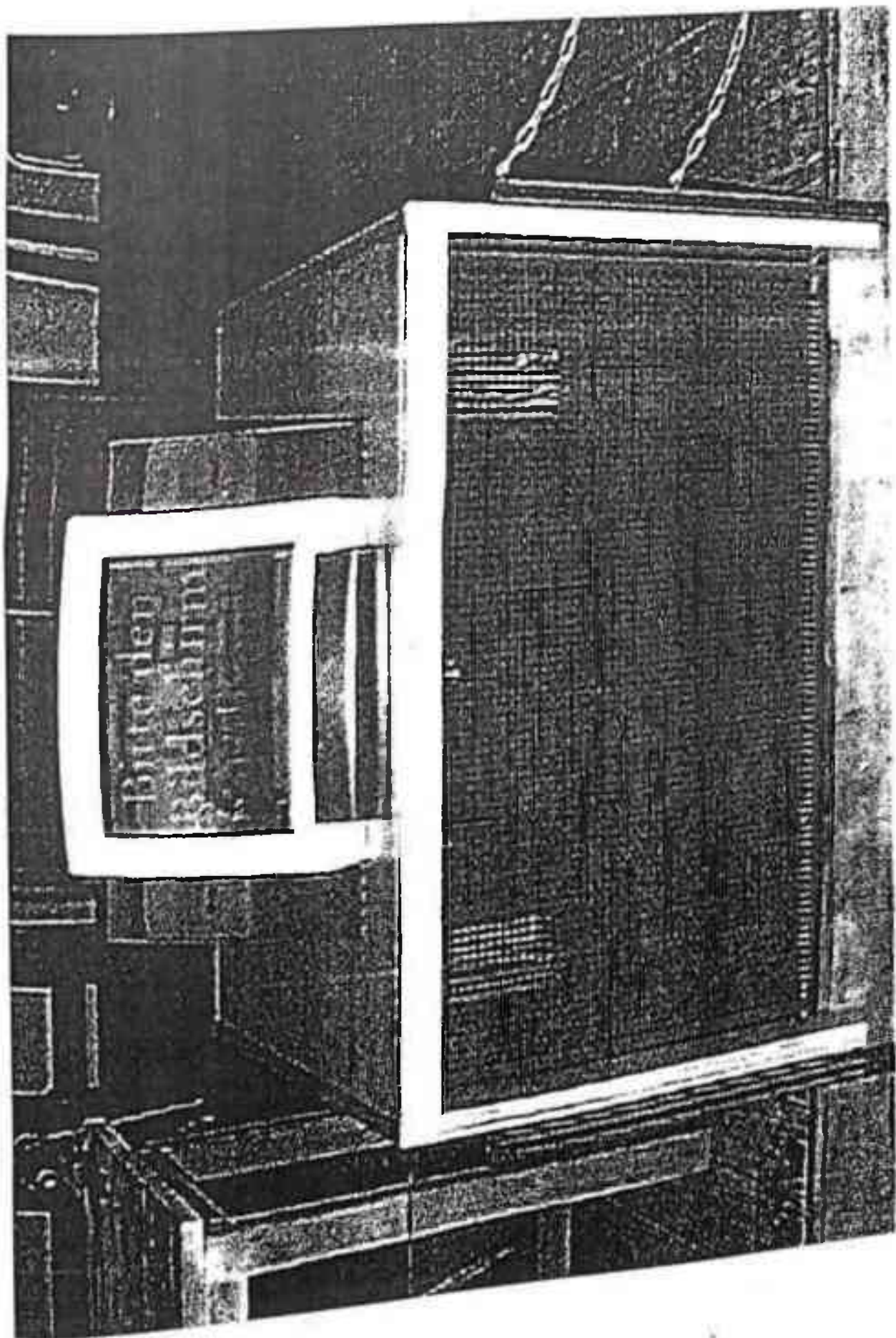
Button for operations 1	Button for operations 2	Button for operations 3	Activities / ways
Main Menu			Automatical transit 1.1
Remarks for the software			Links
After a defined time the System should return to the starting screen (0.1).			1.1: 0.3
			Number of branches
			two

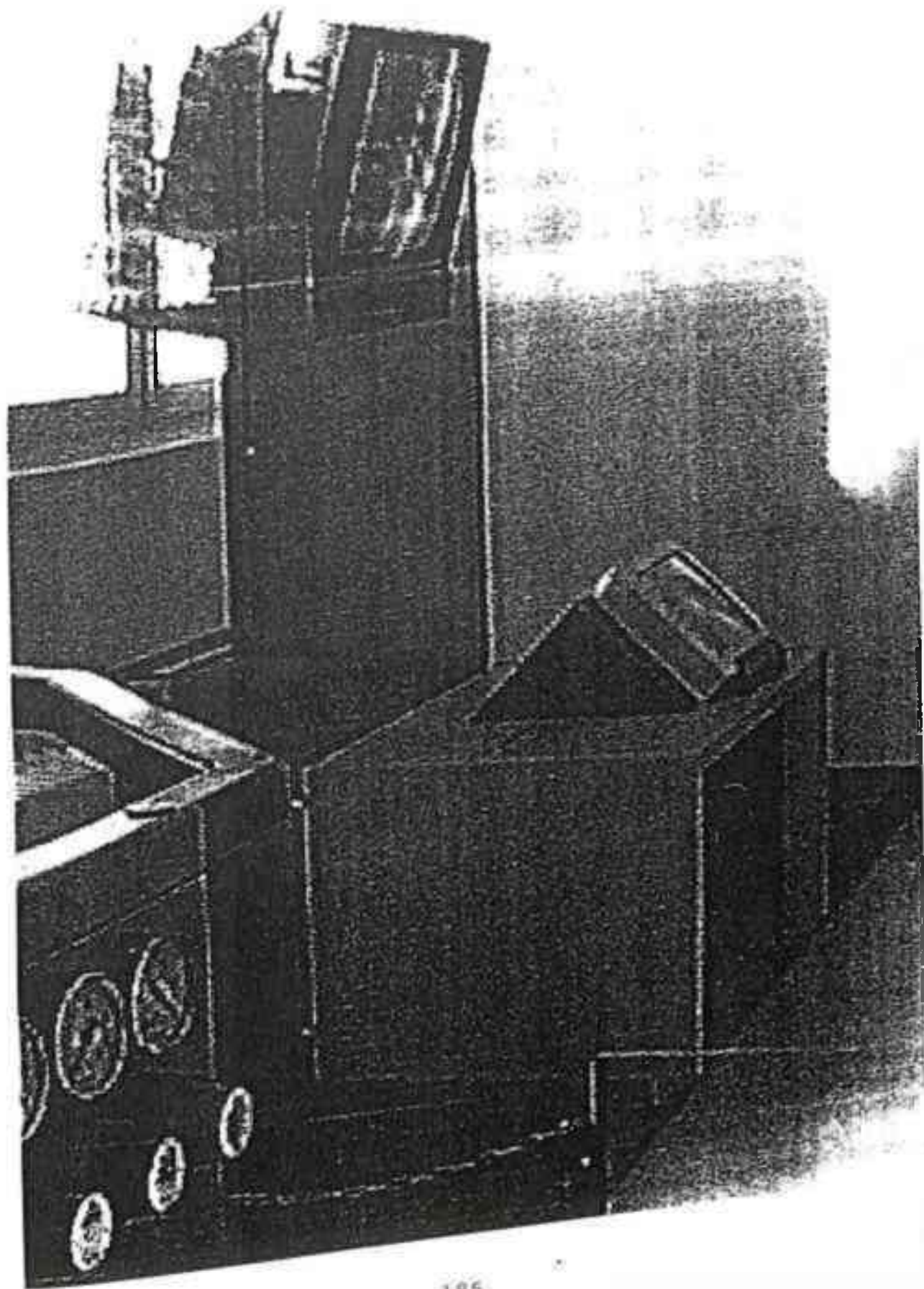
Hardware

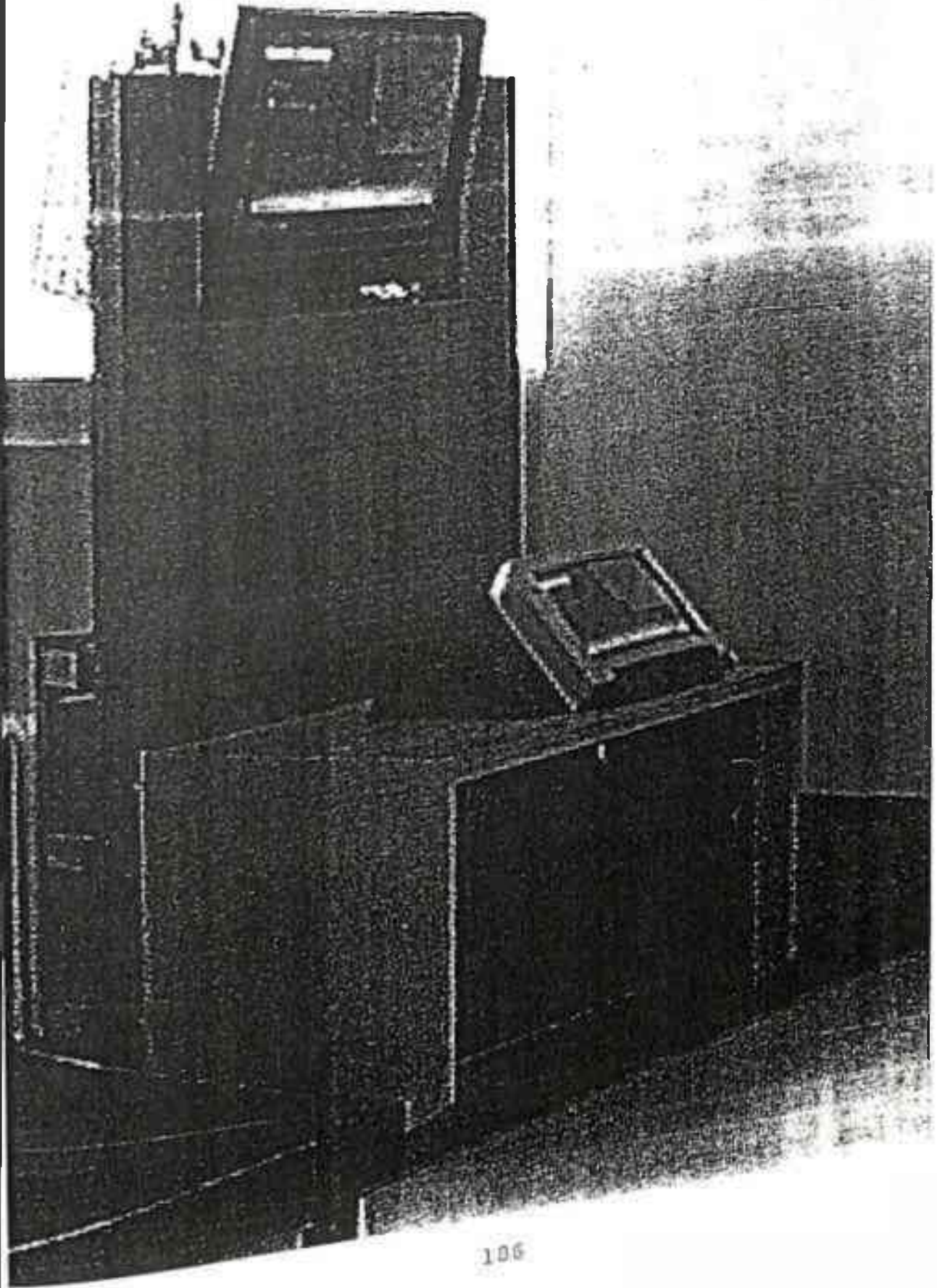
Descriptions

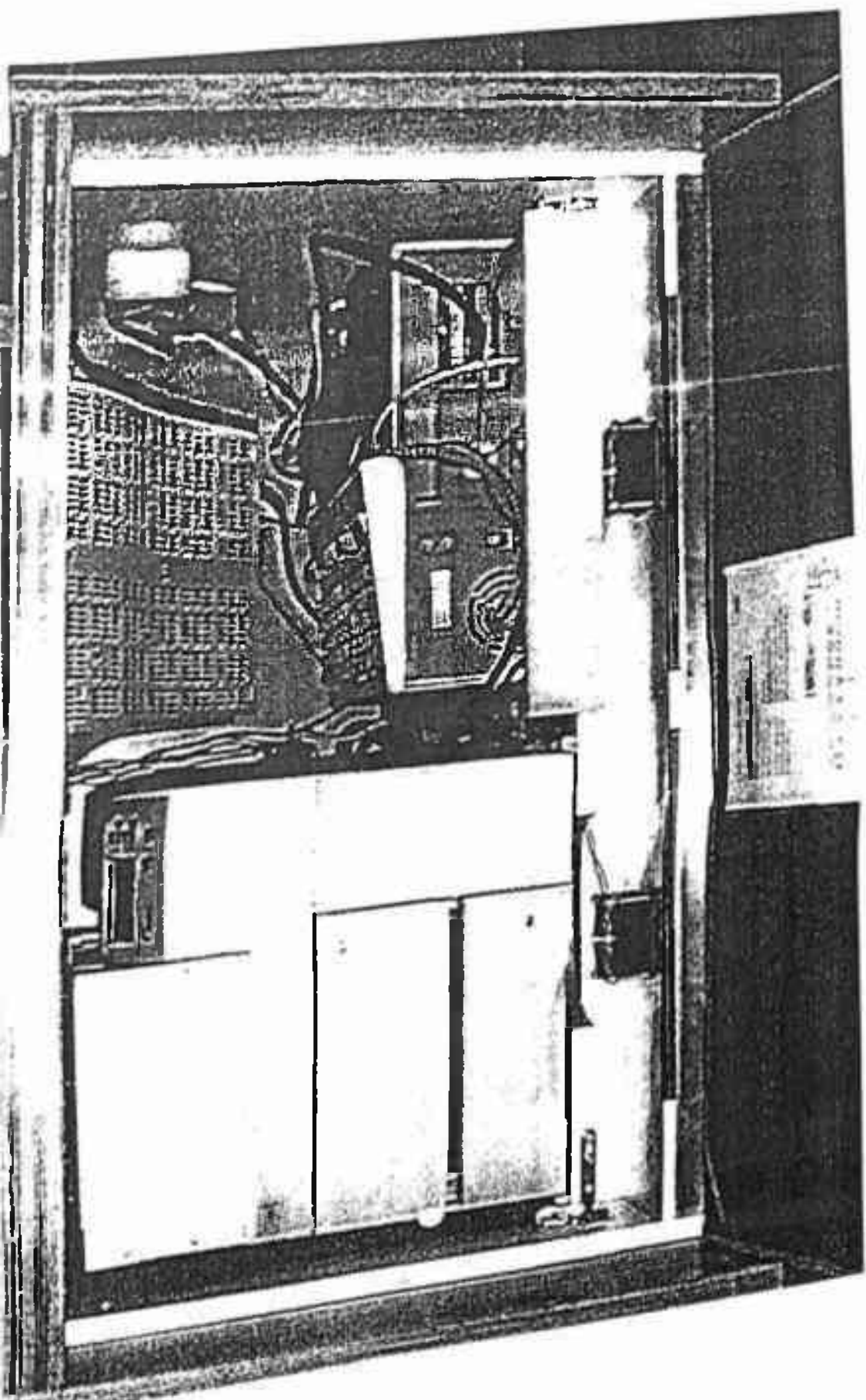
In the Gallery "Printing" of the Deutsches Museum we use the following hardware for the Multimedia-Stations:

1. IBM Personalcomputer, Intel Pentium 586/ 90 Mhz/ 16 MB RAM/ 1 GB harddisk
2. Touchscreen Monitor, Philips, 17"
3. Lexmark Laserprinter
4. Large Display Monitor BARCO OCM 3346/ 755mm x 652mm x 547mm
640 pixel horizontal resolution









Appendix No. 07

On

"Synopsis of Publications"

LIST OF PUBLICATIONS :

1. Utility of Science Centres : R. Madhavan, Communicated to *Current Science*, July, 1987.
2. Effect of Science Centres over India : R. Madhavan, Communicated to International Council of Museums (ICOM), France, March, 1997.
3. Visitor's Reaction on S&T Exhibits of Science Centres : R. Madhavan, Communicated to "Iranian Journal of Science and Technology" Iran, August, 1997.
4. Expected learning styles of visitors in a Science Centre of a developing country: R. Madhavan, Communicated to *Journal of Higher Education*, Ohio, August, 1997.
5. New conceptual design of a science gallery for a modern Science Centre : R. Madhavan, Communicated to the Institution of Electronics & Telecommunication Engineers (IETE), New Delhi, August, 1997.
6. A multimedia design for a science gallery - Ceramics & Glass : R. Madhavan, Communicated to "Museum International", Paris, August 1997.
7. Structural elements for a modern Computer science gallery : R. Madhavan, Communicated to "Everyman's Science", Indian Science Congress Association, Calcutta, August, 1997.
8. A Study on review of S&T resources for the present society : R. Madhavan, Communicated to "Science Reporter", National Institute of Science Communication, New Delhi, August, 1997.
9. "Our Environment", Presented a paper on the world environment day conducted by Institute of Engineers, Tamilnadu circle, June, 1997.

N.B. The synopsis for the above publications were enclosed in Appendix No. 07.

A SHORT LETTER:

UTILITY OF SCIENCE CENTRES:

The idea of my topic is to analyse the present Science and Technology Centres for the reaction of the people on a Science Centre like Tamilnadu Science and Technology Centres (TNSTC). Towards this goal, a questionnaire method has been selected for surveying the views of the visitors to Tamilnadu Science and Technology Centre. This Centre has a modern Planetarium and Interactive Science Exhibition having Seven galleries on Science and Technology and outdoor exhibition parks such as Science Park, Traffic Park, ECO park, Meteorological Observatory Park. The Campus has facilities such as a Souvenir Shop, Canteen, water closets and Bathrooms for catering to the needs of the visitors. Now a sample survey has been conducted by selecting a random sample of 200 visitors.

This analyse is to emphasise the utility of Science Centres. The results of my survey fruitfully agrees to the people's acceptance of science Centres in their day-to-day affairs.

The type of questionnaire circulated to visitors has the following themes:

1. Demographic Values
2. Influence to visit Science Centres
3. Timing Factors
4. planetarium Show Programmes
5. Facilities

6. Indoor/Outdoor Exhibition.
7. Comparison of different halls of Science
8. New ideas from visitors

The visitors who gave their views on Science Centres are of employed adult literates. Views expressed by them are analysed as follows. Random data collection indicates that visitors to Science Centres are influenced by maximum number of friends than other categories such as children and news items. It is also inferred from the data that the aim of the visitors is to seek the knowledge of Science rather than entertainment which is of 20% in comparison with 78% for knowledge. The most preferable months for visiting the Science Centre and Planetarium are May, December, November, April, October and January respectively in descending order. Generally, 84% of visitors are satisfied with the civic amenities.

Many visitors are expecting to have good Souvenir Shop having more scientific and technological toys. Only 58% of the visitors have responded for the Souvenir shop. The advertisement required for this Science Centre has been emphasized by the visitors. Visitors could not locate the advertisement boards of this Centre and hence there is only 10% of visitors who have seen the advertisement boards. More than 60% of the visitors have preferred the canteen facilities. About 78% of visitors accepted the vehicle

parking rates.

Planetarium programmes are usually liked by the visitors. About 48% of the visitors have accepted that they have often seen the planetarium programmes.

About 90% of visitors have agreed to the present entry rates of Planetarium shows and Science Centre. About 80% of the visitors have liked the Planetarium shows and the Science exhibits. It is noted that 70% of visitors have covered all the galleries of this Centre. This indicates their interest to learn all aspects of Science and Technology. Among all the Science and Technological galleries, Electronics & Communication gallery has been liked by maximum visitors of 52%. This shows that the tendency of visitors is towards the modern communication technology which is entering in full stream into this 21st Century.

90% of people of all categories feel that Science Centres inculcate curiosity in Children. They prefer to bring more children, the younger generation, for exposing them to the new feast of Science and Technology developments. Also they prefer to learn in their own styles in Science Centre rather than to make fun like in other entertainment places.

Finally, the concept of Science parks, i.e. Science with no boundary walls, has been preferred by the visitors. The data shows that 79% of visitors preferred the concept of Science parks for its better clean environment.

From my above study, it is inferred that the new concept of Science Centres, Planetaria and Science Parks have created very important Science and Technology Resource for knowledge seeking people. Thus they have made an impact on society by awakening the minds of people to utilise the Science Centres. They prefer to use the Science Centre as a substitute for learning during the summer holidays, festive days and free-time instead of the usual formal academic learning. This way, the Science Centres, infuse the inadequacy created in Formal education.

ER.R.MADHAVAN
JOINT DIRECTOR (ELECTRONICS)
TAMILNADU SCIENCE AND
TECHNOLOGY CENTRES,
GANDHIMANDAPAM ROAD
CHENNAI - 600 025

Effect of Science Centres Over India

Synopsis :

Education provides knowledge to the people. People derive the knowledge not only from the formal usual education but also from the other media sources such as Newspaper, Radio, Cinema, Television, Exhibitions and Museums. As the present generation of the people are immediately in favour of adapting to the new developments in every fields, it is the utmost requirement expected from different sources to provide the quick knowledge about the various products of the fields such as Science, Technology, Economy, Agriculture and Environment.

One of the sources from which the above said benefit can be derived, is the modern concept of "Science Centres" which are existing in various countries of the world. In India, during the last decade, the Science Centres have been built and opened to the public for learning in an informal way. One of such Science Centres, namely Tamilnadu Science & Technology Centres (TNSTC) in Madras has been established and opened to the public from 17th September 1990.

The effect of this TNSTC over the people of Tamilnadu and neighbouring states in India has been studied and evaluated through the method of survey known as "Questionnaire on Science Centre". The data collected are from a random sample of 200 persons who have visited this centre.

The questionnaire, consisting of factors such on Demographic values, Influence, Timing, Facilities, Planetarium Shows, Outdoor Exhibition, Science parks, New ideas from visitors reinforces the fact that "Science Centres" is a must for the present and future generation.

The expected changes needed for the existing Science Centres have also been derived from the data and found that essential prerequisite of the Science Centres is to have many well-maintained participatory exhibits which can be handled by visitors and infer the knowledge. Also many people who are not exposed to science subjects realise their ignorance towards their lack of knowledge on the achievements of science and technology. Thus, the attempt made in the questionnaire reveals the fact that many more Science Centres have to be established in different fields.

Abstract on

Visitor's Reaction on Science and Technology Exhibits of Science Centres

by

Er. R. MADHAVAN

Joint Director

Tamilnadu Science & Technology Centre

Chennai - 600 025

India

The formation of Science Centres in the world has created an immense impact on the acquisition of knowledge of Science and Technology (S & T) by the masses. The main ingredients or the products of such Science Centres are the S & T exhibits which have been displayed differently in the halls of the Science Centres. Hence it is more apt to study the reaction of the visitors who are the real customers to the Science Centres on the S & T exhibits. The study of the reaction of the visitors helps the authorities mainly in two folds. The first one is to know whether the visitors satisfy with the existing working models. The second fold is to incorporate the modifications and install new models as expected by the visitors.

Towards the achievements of the above goals, this study has been carried out in one such Science Centre namely Tamilnadu Science and Technology Centres (TNSTC), in Chennai, India. TNSTC is consisting of four galleries on S & T such as Transport, Electronics & communication, Physical Science and Energy. The study has been implemented on selecting a sample of few exhibits in each of the above four galleries (total 14 exhibits). The process of getting feedback from the visitors is done through the Questionnaire method. The sample size is 200.

This analysis brings out that the visitors prefer to have working models rather than static models. They expect some rare big models in the centre, which they could not get a chance to see. The science exhibits need good aesthetic look and animations so that they can be attracted by the visitors eventhough the concept of the exhibits could not be understood shortly by the visitors. The analysis also shows that the visitors can rank themselves the ideas of the exhibits. Funny images and curved shapes are being liked by the visitors than the regular structures. Also it is clear that 50% of visitors have no patience to look for the labels or write - ups in the exhibit. So attractive labels and flip-on have to be made and installed in the proper place on the exhibits. It is also advisable that the more complicated principles may not be exhibited in the halls since most of the visitors skip them due to their lack of knowledge.

The above results have been inferred from this study and the 14 histograms present the overall view of the expectations of the visitors.

(R. MADHAVAN)

To

The Editor
Iranian Journal of Science & Technology
71344, Shirz University
Shiraz, Iran.

Abstract on

Expected Learning Styles of visitors in a Science Centre of a developing Country

by

Er. R. MADHAVAN

Joint Director

Tamilnadu Science & Technology Centres

Chennai - 600 025

India.

The Role Efficacy of Science Centres to make a good impact on Society needs to evaluate the learning styles of visitors who belong to the same society. This evaluation paves the ways for the authorities of Science Centres to equip the necessary tools and measures for the up-keep of the Science Centres to the satisfaction levels of the societal members. The methodology adopted in this process of evaluation of 'Learning Styles' is the questionnaire method. The primary raw data collected from this methodology have given the necessary feedback on learning styles of visitors to the Science Centre. In this context, the Tamilnadu Science & Technology Centre, Chennai, India has been selected as a venue for collecting data. TNSSTC has a modern sophisticated planetarium and a science exhibition of 7 galleries such as Transport, Energy, Materials Science, Life Science, Innovative, Electronics & Communication and Physical Science. The questionnaire deals the aspects of reading habits, concentration, motivation, nature, strength, structural and operational tastes and visionary likings of the visitors.

The questionnaire contains 17 questions. The questions relate to the analysis of demographic details, professional levels, learning strength and concentration levels, learning methodology, Environment attachment and companion liking, required atmosphere of learning, motivation and finally operation & assessment of Science Centre towards the objective of disseminating the knowledge of S & T to the masses.

The conclusion of the data analysis indicates the two levels of rankings, one above 50% and the other below 50%. The above 50% level ranks consist of liking of modular structure, self - operation and the see - do - understand phenomenon. The ranking of regular concentration, friends companion, working sound background and do - it - yourself stands below 50% level of ranking. The authorities of Science Centres have to adopt the above 50% ranking so that the science exhibits are to be made with respect to the above phenomenon. It is also inferred that a relaxed quite environment of morning time before noon with fine structure of exhibits is the learning set - up required by the visitors.

(R. MADHAVAN)

To

The Editor
Journal of Higher Education
Ohio State University Press
1070 Carmack Road
Columbus, Ohio 43210 - 1002.

SYNOPSIS

NEW CONCEPTUAL DESIGN OF A SCIENCE GALLERY FOR A MODERN SCIENCE CENTRE

By

R. MADHAVAN

Joint Director

Tamilnadu Science & Technology Centre,
Chennai - 600 025, India

The Concept of Science Centres evolved during the last two decades for educating the S&T to the masses in a non-formal way has been further promoted by creating new designs in the design of Science Galleries. As the main aim of the Science Centres is to popularise S&T concepts to the general public and students, it is also felt utmost important that the Science Centres have also to come closer to general public by introducing the new concepts. The idea of my topic is to introduce one such novel concept on the design of Materials Science Gallery which is one of the present thrust areas in S&T field.

The design of Materials Science Gallery is consisting of eight major spatial sections, managing from Metals to Stones. Each spatial section is divided into four groups that repeat themselves in every sections. The four groups are general information, properties and structure, methods of preparation and final products. They defer from one section to another. As the requirements or demands arise, one material may not have the properties needed for designed purpose. Therefore, a combination of materials must be applied. In the Materials Science Gallery, it is to react to this state of art by integrating and connecting all sections through transit elements.

The thematic entrance to the Materials Science Gallery starts and ends with Ore/Minerals. All the main spatial blocks are inter-connected by means of transit area blocks which have inner significance of the prior and post departments of the main blocks. The transition from one block to another is realised by means of transit areas. The transit areas are of vital importance for learning the developments of new components for the modern future requirements.

As there are totally eight main spatial units, there are eight transit units. The chaining of the main units with the transit units while designing a gallery is the main important concept to be introduced in the future Science Centres. The idea behind it is to create the historical connections among the amalgamation of materials.

People who visit this type of designed galleries will have a ^othrough understanding of the subject. While they are visiting the gallery, they will be landed into the respective slots of coherent connection of the subjects. This paper deals with the formation of main spatial units and their corresponding interconnecting transit units for the Materials Science.

(R. MADHAVAN)

To

THE MANAGING EDITOR
Institution of Electronics & Telecommunication Engineers (IETE)
2, Institutional Area
Lodi Road
New Delhi - 110 003.

SYNOPSIS

A MULTIMEDIA DESIGN FOR A SCIENCE GALLERY — CERAMICS AND GLASS

By

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Joint Director

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The new novel design using multimedia system for the Ceramics and Glass, the important materials of the present time in the Materials Science Gallery, has been carried out with the Criterias such as content, media structure, methodology and planning & creation.

The content is based on general & technological structure, integrated aspects, historical dimension, relation to objects (Museum orientation), visitors' orientation. The structure of the media consists of the major elements such as written information, still and moving images like photos videos and films, audio and instruction elements. The four methodology prerequisites such as an integration of a variety of elements, learning through examples, explicit information, visitor's own decision making are indispensable for a successful multimedia system. Crucial points for the methodology are the comprehensibility and clarity, flexibility, easy accessibility and guidelines for operations. The planning and creation levels are creation of a treatment, script writing & management, screen design / media processing, programming, building of the stations/ kiosks, implementation, maintenance and service including the contracts and finally the use of the multimedia system outside the museum.

A matrix tree-diagram is designed for multimedia Ceramic and Glass. It consists of Ceramics, Glass, Computer game and Journey through time. Necessary data files have been created for making a multimedia system for the above four programmes.

The main idea is to allow the visitor to select any of the four programmes by a screen - touch and the visitor has full liberty to continue or discontinue in that sequence or he can restart another sequence by his liking. It is to gain full freedom to the visitors for selection of his choice and learning at his will and pleasure.

Sequence of operations to enter the multimedia station are moving screen, language selection, the main menu selection, Ceramic / Glass station, computer game selection and journey through time.

This paper deals with the complete design of the above aspects of software and hardware of the multimedia kiosk for a modern Science Centre which has a vital role to play in changing the society towards the prosperous environment.

(R. MADHAVAN)

To

MARCIA LORD
Editor-in-Chief
Museum International
Division of Cultural Heritage
UNESCO
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SYNOPSIS ON STRUCTURAL ELEMENTS FOR A MODERN COMPUTER SCIENCE GALLERY

BY

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As the Computer has many component elements such as Central Processing unit (CPU), Arithmetic Logic Unit (ALU), Memory and Input & Output (I/O), the Computer Science Gallery has also been depicted in the form of the above structural set-up elements. This paper deals with such a new structural design. It is a well-known fact that the Computer Science is one of the modern thrust areas to be seen at every places in the World. This Science, compared to other Sciences, has gained its importance due to its rapid changes in its design & technology and people are finding very much difficult to cope up with the updation of the various versions of this technology. The design of this Computer Science Gallery is based on the above criteria for the present and future generation of the younger people.

The Computer Science Gallery has the four major divisions such as Intrinsic, Logic, Programming and Extrinsic. The Intrinsic Division has the elements such as Computer elements, Technology of chip and Intel's Pentium; the Logic Division includes physical model of a chip, Interactive system and Cryptography; the Programming Division is Composed of Programming, Links of Computer System Software & Hardware and Quantitative controls; the fourth division namely Extrinsic type has Large screen displays, Uses of Computers and Multimedia systems.

The above idea of forming the gallery initiates the visitors to enter into the respective slots and understand the content of the interactive exhibits. In fact the interactive exhibits kindle interest in the younger generation for developing skills, for acquiring the requisite knowledge, for understanding their applications as well as for utilising the potentialities of Computers in their day-to-day activities.

R. Madhavan

(R. MADHAVAN) 10/9/95

To
The Hony. Editor
Everyman's Science
Indian Science Congress Association
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SYNOPSIS ON A STUDY ON REVIEW OF S & T RESOURCES FOR THE PRESENT SOCIETY

BY

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The aim of this study is to evaluate the status of knowledge on Science and Technology (S & T) which have reached the Society and to assess the improvements required for percolating Science and Technology awareness amongst the society. Towards the achievements of the above goal, the resources available in the field of S & T such as Policies, Planning & Budgeting, Appropriate Technology, Meteorology, Conservative techniques, Popularising activities from the Publication to the Establishment of Science Centres etc., have been studied and analysed. Mainly, the study on Scientific knowledge required for Human Resource Development (HRD) which is the burning problem in our country, has been given much importance.

The immediate societal expectations are Eradication of poverty, Provision of adequate food, Nutrition, Clothing & Shelter, better opportunities for Health and Education, Industrial Developments etc., The resources and developments available in S & T have to fulfil the above expectations of the weaker sections. This study has enumerated the various constraints and barriers come across during the implementation of satisfying the societal expectations.

Hence as the societal expectations from the Scientists and Engineers are in great demand compared to their limited implementation processes, it is highly essential to search for available resources. The different resources have been analysed in this report.

From the above indepth study on the Science and Society aspects especially in relation to the resource requirements for assessing awareness and for evaluating the quantum of knowledge on S & T, it is crystal clear that the developments in S & T for the society should be for peaceful purposes.

Finally, an effective interface has to be abridged between Science and Society. This can be achieved only by creating the infrastructure such as modern concept of Science Centres or Science Museums where the society will be brought nearer to the uses of Science, by means of interactive exhibits on the various fields of S & T.


(R. MADHAVAN) 10/9/97

To
The Editor
Science Reporter
National Institute of Science Communication
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SYNOPSIS ON "OUR ENVIRONMENT"

PRESENTED BY

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Environment is the sum of all external conditions and influences which affect the life and development of all organisations. The characteristics of our environment, study on environment system in terms organisms, social and cultural factors and human impact have been discussed in this paper. Human influence on Environment, managing the garbages and social wastes have been described and explained with suitable examples.

The cyclic or perpetual motion of the development of Environment has been studied in this paper.

Pollution of Environment has been studied in terms of prosperity, poverty and traditional habits and attitudes. In addition to the above physical visible pollution of environment, the silent invisible pollution of environment Electro-Magnetic Interference (EMI) has also been studied.

The solid wastes in the house are also a threat to Environment. The percentage of solid wastes in average house-held is also listed out. Among the above wastages, paper seems to be at the top. Hence utilisation of the waste papers to good papers has been stressed in this report. So proper utilisation of the above wastes may improve our environment and economy of life. There are many methods to utilise the waste material such as recycling processes, reusing the items and burning to produce energy etc.

R. Madhavan
10/9/97

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