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## CONTENTS

1.	A QUESTIONNAIRE-BASED SURVEY OF GREEN SENSE AMONG UNDERGRADUATE STUDENTS RESIDING IN DELHI/NCR	2-11
	<i>Dr. Uzma Nadeem, Dr. Kavita Singh and Prof. (Dr.) Harpreet Kaur</i>	
2.	EXPERIENCE OF SCHOOLING IN AN EXPERIMENTAL PEDAGOGIC APPROACH: A CASE STUDY OF 'CHANAUTI 2018	12-27
	<i>Ms. Taruna Jain</i>	
3.	SHORTEST PATH ALGORITHMS: COMPARISON AND APPLICATIONS	28- 58
	<i>Korada Vaishali, Muskan Lakra, Ramita Sahni and Rashmi Verma</i>	
4.	संस्कृत साहित्य में मानववाद	59-68
	<i>Pooja Mishra</i>	
5.	RISK MANAGEMENT DISCLOSURES AMONG THE FINANCIAL INSTITUTIONS: AN OVERVIEW	69-83
	<i>Dr. Harshmeeta Kaur Soni</i>	
6.	A CASE STUDY ON THE IMPACTS OF ONLINE MODE OF LEARNING ON EDUCATION	84-99
	<i>Kaveri, Navpreet Kaur, Sonam Kandar, Prarthna Singh, Mridula, Shreya, Shashwati</i>	
7.	BEHAVIOURAL NUDGES IN THE ARENA OF MACROECONOMICS IN INDIA: MAKING A DIFFERENCE IN HEALTH AND EDUCATION	100-108
	<i>Parnika Trivedi and Dr. Meenakshi Sinha Swami</i>	
8.	SPECIAL TYPES OF MATRICES AND THEIR APPLICATIONS	109-125
	<i>Harneet Kaur Matharoo, Rashmi Verma, Salvi Jain and Sonia Aneja</i>	
9.	ਸੱਤਾ ਦਾ ਪ੍ਰਵਚਨ : ਮਿਸ਼ੈਲ ਫੂਕੋ	126-133
	<i>Harwinder Singh</i>	
10.	ਤੂੰ ਹੀ ਦਸ -ਇਕ ਅਧਿਐਨ	134-138
	<i>Iqbal Kaur</i>	

## A QUESTIONNAIRE-BASED SURVEY OF GREEN SENSE AMONG UNDERGRADUATE STUDENTS RESIDING IN DELHI/NCR

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### ABSTRACT

*Environmental education and awareness along with participation can begin at the early stages of education; however, at the higher education level students not only can learn and accumulate knowledge about the environment but they can also develop responsibility towards the stewardship of the ecosystems and respect other species' right to a healthy environment. Assumption is that educational institutions are appropriate venues to propagate such awareness. How people react and behave in return to ecological problems is important in perceiving responses from individual groups. Behaviour is one of the important factors which determines environmental awareness. Students nowadays pay less attention to their environment and as future decision-makers of the society their attitude towards environmental protection and economic priorities and issues and efforts are vital to one's society and its developing cycles. Overall, greening the educational institution has become an important issue as the future decision makers are prepared to have commitment to protect and value the environment and university's commitment to a green education agenda on the other hand.*

*A questionnaire-based survey was conducted to analyse the environment awareness and participation level in environmental protection activities by undergraduate students of Delhi/NCR region of Mata Sundri College for Women, University of Delhi. As per the analysis of the responses received it was observed that the level of awareness of students was found to be far above the ground but it was also observed that the percentage of students with high levels of awareness is extremely low whereas, a very high percentage of students was observed with very low level of environment awareness. Moreover, the level of environmental awareness amongst the students is very high with constructive attitudes towards the environment, but the participation level in environmental protection activities is moderate. The questionnaire survey highlighted that student are concerned about environmental issues but up to some extent and also expressed a very positive behavior.*

**Keywords:** Environmental awareness, Environmental knowledge, Students, Questionnaire, Survey

### INTRODUCTION

Environment is pivotal and humans are dependent on the environment for our survival and quality of life. It has been observed that species and environment both are interdependence to each other and in the last few decades we have observed the widespread incidence of environmental degradation, natural calamities all over the world due to the consequences of overexploitation by anthropogenic activities majorly by urbanization and industrialization. Therefore, there is a need to draw the attention of the global community to work for a better environment by adopting sustainable development practices.

With the growing population demand for basic needs leads to waste generation which is the main cause of environmental quality degradation. Various kinds of pollution of the environment result in

serious health hazards on humans (Karatas et al., (2016)). The chemical responsible for the degradation of quality of each component of the environment reaches to the organs of the human body via food chain which leads to biomagnifications in the organs and causing cancer.

In the past few decades, global problems concerning environmental pollution have been increasing day by day and extreme use of non-renewable natural resources leads to the depletion of the resources. Major issues we are facing are fresh water scarcity on a global scale, deforestation, degradation of area around the rivers, depletion of soil quality and biodiversity loss, pollution, over exploitation of energy resources and increase in solid wastes have become a major concern. Increased levels of pollution have resulted in serious health problems like cancer, as well as adverse impact on the environment, and certainly inducing projections for long-term monetary progress. The main sources responsible for the contamination of water are industrial effluent, domestic sewage, agricultural runoff, medical wastes, institutional waste etc. (Lutterodt, et al., 2018). Environmental pollution has a direct and indirect effect on health. So, there is a need to create environmental awareness among the students related to environmental degradation and its management by environmental education from the childhood age.

The term environmental awareness means knowledge about the environment which offers skills to solve environmental problems. Apart from education there is a need of vigorous checking of the awareness and consciousness level of the students by various research methodologies. Some of the literature reviews depicted the awareness level of the student's related environmental problems as an individual (K. Ghosh, 2014; Abbas and Singh, 2014; Sindu and Singh, 2014; Kumar, J., 2012; Danielraja. R., 2019; Ahmad et. Al, 2021; Verma, A. & Verma, V., 2022).

To attain sustainability in the environment, awareness by education and public contribution is the key requirement and according to UNESCO (1981), environmental education is a method of executing the goals of environmental protection. It is not a separate branch of science but a lifelong interdisciplinary field of study. Which suggests that education towards protection and improvement of the environment and education works as a tool of development for refining the quality of life of social communities and to attain this goal, environmental education and awareness turn out to be important tools to encourage community participation in environmental protection and conservation.

This research paper tried to analyse the environmental awareness amongst the undergraduate students of Department of Environmental Studies of Mata Sundri College for Women of University of Delhi by a questionnaire-based survey.

The main objective of the survey is to study the student's environmental awareness and participation for the management of the environmental problems related to their college campus and their residential area. The outcome provided the idea regarding the awareness level of students regarding environmental initiatives which should be taken in the campus and their residential areas. This survey investigated the levels of awareness in terms of environmental issues among the undergraduate students and the students participating in the survey mostly belong to Delhi/NCR region.

The study has been undertaken to analyze: (1) level of environment awareness; (2) sense of responsibility and attitudes of students towards the environment and its issues; and (3) student's participation and engagement level of students in various environmental protection activities.

## METHODOLOGY

**Research sample:** The survey was conducted among undergraduates of the age group 18-21 year. The survey included a closed-ended questionnaire and the students responded voluntarily. During the survey a goal-oriented sampling method was adopted and we have received a total 701 responses over the prescribed timeline. The survey questionnaire consists of four sections related to general environmental awareness, energy and water issues awareness, waste management and water pollution and health awareness (Annexure -1).

Research analyses report comprises weighing the data, calculation of descriptive statistics and percentages calculation on the basis of student's response. The outcome provided the idea regarding the awareness level of students regarding environmental initiatives and the responsibility of the students as an individual in the campus. Moreover, issues related to poor water quality status at their residence and techniques they are using for the purification of drinking water along with energy conservation and waste minimization strategies.

**Questionnaire design:** In the questionnaire, questions were composed with the format of pre-selected answers and were used as the main tool of this research. The survey also collected some demographic information including age, gender, and education etc. of the students.



## RESULT AND DISCUSSIONS

The results from the study revealed that students have high environmental awareness, and positive attitudes towards the environment, but moderate levels of participation in environmental protection activities and improvement.

Analysis of section 1 of environmental survey questionnaire representing general environmental awareness among undergraduate students: As depicted in Table A almost fifty three percent (52.99%) of respondents stated that litter/ garbage and trash are the most important environmental issue on campus whereas other issues like water issues, pollution, energy issues and green cover were less vital. Awareness of all these issues have to be intercalated among the students to increase conservation programmes. Maximum students were aware of domestic and industrial waste categories whereas awareness of other waste categories like commercial, biomedical, construction/demolition and e-waste were lacking. The next awareness question about environmental initiatives in the college campus showed that purchasing recyclable products, the use of alternative energy sources, sustainable use of water along with reduction of plastic use should be at par except composting. Composting being one of the most important initiatives has to be understood by the students. Moreover, maximum students were unaware about the functioning of the eco club in the college campus.

**Table A: Analysis of section 1 of environmental Survey questionnaire representing general environmental awareness among undergraduate students. Number of students who responded to the questionnaire was 701.**

S. No.	Close ended questions	Selective preferences	No. of response	% Response among students
Q. 1	What is the most important environmental issue on campus?	Litter/garbage/trash	372	52.99
		Water Issues	230	32.81
		Pollution	174	24.82
		Energy issue	59	8.42
		Green cover	179	25.53
Q. 2	How many waste categories are you aware of?	Domestic waste	608	86.73
		Industrial waste	545	77.75
		Commercial waste	347	49.50
		Bio-medical waste	338	48.22
		Construction/demolition waste	372	52.07
		E-waste	331	47.22
Q. 3	What environmental initiatives should be taken in your college?	Purchasing recyclable products	274	39.09
		Using alternative energy sources for campus needs	337	48.07
		Sustainable use of water	319	45.50
		Plastic use reduction	290	41.31
Q. 4	Are you aware of the functioning of the Eco club of your college?	Yes	308	43.93
		No	393	56.06

Analysis of section 2 of environmental survey questionnaire representing awareness about energy and water issues among undergraduate students: As analyses in Table B majority of accepted that they make effort to reduce energy and water consumption at their residence always or sometimes. Only a few students responded that they never take any effort to reduce the consumption of energy and water at their residence. Majority of students turn off the tap while brushing teeth, hand washing, shaving etc. at their residence while other initiatives like reducing the shower time, reusing the water, less capacity flushing, washing only full loads of laundry showed less response from students. Previous socio-economic behavioural research studies have demonstrated that primary education can be a big influencing factor in creating awareness towards issues related to water and household activities on hygiene (Plappally, et al, 2011). Majority of the students replied about supply of drinking water via Municipal Corporation. Maximum students used to turn off the lights when not in use, use CFL/LEDs to conserve the energy along with turning off the electronics when not in use.

**Table B: Analysis of section 2 of environmental survey questionnaire representing awareness about energy and water issues among undergraduate students. Number of students who responded to the questionnaire was 701.**

S. No.	Close ended questions	Selective preferences	No. of response	% Response among students
Q.1	As an individual how frequently do you make efforts to reduce energy and water consumption at your residence?	Always	304	43.36
		Sometimes	379	54.06
		never	19	2.71
Q.2	Which of the following ways do you adopt to conserve water at your residence?	Reduce shower time	303	43.22
		Turn off the sink while teeth brushing, hand washing, shaving, etc.	624	89.01
		Only wash full loads of laundry	155	22.11
		Reusing water	268	38.23
		Using less capacity flush tanks	180	25.67
Q.3	Are you aware of your drinking water supply?	Municipal corporations	450	64.19
		Well, / groundwater	190	27.10
		River	52	7.42
		Tap	116	16.55
		Don't know	116	16.55
Q.4	In which of the following ways do you conserve energy at your residence?	Turn off lights when not in use	522	74.46
		Turn off electronics when not in use	461	65.76
		Use Compact Fluorescent Light bulbs (CFLs) /LED's	469	66.90

Analysis of section 3 of environmental survey questionnaire representing waste management awareness among undergraduate students: As assessed in Table C maximum students used two dustbins at their home for waste segregation. The result indicates that very few students are aware of waste segregation methods and their importance. Larger numbers of students reuse and recycle newspapers, old notebooks and old clothes whereas fewer students were aware about recycling cell phones, batteries and cells. Recycling of cell phones, batteries and cells are very important environmental concerns. Maximum number of students used double sided copies along with avoiding plastic packaging but fewer number of students replied in favour of use of reusable plates, cups, or utensils and carrying a reusable bottle or coffee mug on campus. Maximum number of students reported having a recycling bin in their area.

The study indicates the requirement of ecological awareness and citizen participation to segregate waste at source, door-to-door collection, and disposal in appropriate collecting bins is imperative. However, in India, the present scenario reveals that there is almost no segregation of garbage at source which leads to various environmental problems. There is no organized and scientifically planned segregation of municipal solid waste either at household level or at community bins. Lack of coordination among the citizens and lack of planning in some areas of Delhi, the citizens throw litter wrongly. Apart from this, students specified that the community bins are not located in the close locality and similar studies have been reported in the literature (Joshi and Ahmed, 2016). Large number of respondents reuses old notebooks and recycles newspapers and half of the population avoid using plastic packaging indicates the awareness level among the students. Most of the students specified that they use reusable plates, cups and utensils to reduce the waste generation in the campus which is a very sign. The results stated that students are very sincerely aware of waste management and they are adopting the measure to control and minimize the waste generation in the campus.

**Table C: Analysis of section 3 of environmental Survey questionnaire representing waste management awareness among undergraduate students. Number of students who responded to the questionnaire was 701.**

S. No.	Close ended questions	Selective preferences	No. of response	% Response among students
Q. 1	How many kinds of bins are there at your home for waste segregation?	One	326	46.5
		Two	418	59.62
		Four	33	4.71
Q. 2	What type of waste do you often reuse and recycle at	Newspapers	543	77.46
		Old notebooks	466	66.47

	your home?	Old clothes	433	61.91
		Old plastic and glass bottles	307	43.79
		Cell phones	40	5.7
		Batteries and cells	45	6.42
Q. 3	Which of the following ways do you adopt to minimize waste on your campus?	Use double sided copies	379	54.06
		Use reusable plates, cups, or utensils	232	33.09
		Carry a reusable bottle or coffee mug	259	36.94
		Avoid plastic packaging	422	60.19
Q. 4	Is there any recycling bin in your area?	Yes	362	51.64
		No	228	32.52
		Don't know	205	29.24

Analysis of section 4 of environmental survey questionnaire representing awareness about water pollution and health among undergraduate students: As assessed in Table D nearly all students agreed that the most dangerous hazard is posed by environmental pollution. Majority of students responded that industrial effluents are the main cause of water pollution whereas other factors marked as domestic wastes, agricultural runoff; medical and institutional wastes are not a threat to water bodies. Popular technique used by students at their home to purify the water is filtration techniques instead of boiling and chlorination methods. Most students agreed to have good water quality at their locality.

**Table D: Analysis of section 4 of environmental survey questionnaire representing awareness about water pollution and health among undergraduate students. Number of students who responded to the questionnaire was 701.**

S. No.	Close ended questions	Selective preferences	No. of response	% Response among students
Q. 1	The most dangerous hazard to health is posed by environmental pollution.	Agree	700	99.86
		Disagree	29	4.14
		Don't know	40	5.7
Q. 2	Who is responsible for water pollution?	Industrial effluent	625	89.15
		Domestic sewage	465	66.33
		Agricultural runoff	265	37.8
		Medical waste	254	36.23
		Institutional waste	254	36.23
		None	19	2.71
Q. 3	Which safe technique you are using at your home to purify the water?	Boiling	226	32.23
		Chlorination	60	8.56
		Filtration	611	87.16
Q. 4	What is your opinion regarding the water quality of your locality?	Excellent	79	11.26
		Good	355	50.64
		Satisfactory	288	41.08
		Poor	63	8.98

The study concluded that the majority of educated youth (~99%) considered water pollution as an environmental challenge and most of the respondents ranked it as the greatest threat and counterparts with the literature data (Ahmed and Ismail, 2018). The majority of students are aware of water pollution and its causes and also aware of safe water purification technologies.

## CONCLUSIONS AND RECOMMENDATIONS

The study analyses the environment awareness status; sense of accountability, attitudes towards the environment, student's participation and engagement status in various environmental protection activities. Environmental sustainability is not a new concept, but it requires the execution with a long-term series of strategic plan, policy and conservation practices. The students of higher education institutes are the hope for future development of policies and technologies focusing on environment issues.

The survey analysis reveals that students of Mata Sundri College for Women possess a good level of understanding in terms of environmental awareness with positive attitudes to work for the environment protection, but they have a moderate level of participation in environmental protection actions and improvement.

As per the survey analysis, only a good level of awareness of environment, and environment related problems does not motivate students to participate vigorously in the environment protection activities. The results suggested that awareness and knowledge of environment issues does not play a key role in the motivation students to participate in the environment conservation and protection activities.

The study also revealed that students need to acquire good attitudes and a higher sense of responsibility towards the environment along with high environmental awareness. At last, the study suggests that there is a need to conduct some awareness raising campaigns related to environmental issues. Rigorous hygiene practices and environmental conservation issues should also be addressed through organizing widespread public awareness programmes/seminars/activities focusing on sustainable development goals.

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## **EXPERIENCE OF SCHOOLING IN AN EXPERIMENTAL PEDAGOGIC APPROACH: A CASE STUDY OF ‘CHANAUTI 2018’**

**Ms. Taruna Jain\***

*In 2016, Delhi State government launched a major education scheme 'Chanauti 2018.' The aim of the scheme was to enhance the level of reading and writing of students of class VI-IX because otherwise, they are a misfit and tend to drop out before class 10. For this, all students from VI to IX, the government had decided to regroup them all based on a Base Line Assessment. In the first phase of this scheme i.e. Chanauti 2016, Students had been tracked and categorized into Pratibha, Vishwas and Nishtha, in the decreasing order of their level of reading and writing respectively. This study was conducted as a part of research fellowship funded by Child Rights and You in the year 2016-17.*

### **LITERATURE REVIEW ON CHUNAUTI SCHEME**

The term ‘Chunauti’ is the Hindi term for challenge. Delhi State Government had acknowledged that schools in Delhi, particularly Government schools, face high-students’ drop-out rate and there is lack of quality education. In order to combat it, Delhi State Government after winning Delhi Legislative Assembly Elections on 10<sup>th</sup> February, 2015 focused upon the education sector and aimed to improve the plight of education. As stated earlier, Education has been a major concern of this Government and the Deputy Chief Minister Mr. Manish Sisodia is heading the Education and Higher Education sector and actively engages with it. According to Mr. Sisodia, “Chunauti 2018 will enable students studying in government schools, especially Class IX students, to overcome the problems being faced by them due to adverse effects of the No Detention Policy” as quoted on the website of Directorate of Education.

The No Detention Policy (NDP) came into force with the enactment of the Right to Education Act of 2009 and Delhi State Government advocates the scrapping of NDP, as mentioned on the website of Directorate of Education. In fact, the Delhi Legislative Assembly, had on 16<sup>th</sup> December, 2015, passed the ‘The Right to Children to Free and Compulsory Education (Delhi Amendment) Bill’, 2015, (Bill No. 15 of 2015), which recommends an amendment in the Right to Education Act 2009, to do away with NDP.

Chunauti scheme was launched on 30<sup>th</sup> June, 2016 in all Delhi Government schools wherein the objective was that all students will be able to pass the 10<sup>th</sup> board exam by the year 2018. It was



funded by Delhi State Government. According to the scheme, students from the government schools from grade VI to IX were the focus group. Government concentrated upon three subjects; English, Hindi and Mathematics and students who were not at proper level i.e. couldn't read and write properly were taken care of, in order to enhance the capability of reading and writing the subjects. Deputy Chief Minister Manish Sisodia said during a press conference, "Delhi Government is determined to not allow the careers and lives of these students to be scarred by failure for little fault of theirs. The idea behind Chhunauti 2018 is that by the year 2018, all students enrolled in Class IX in the academic year 2016-2017, regardless of their learning levels at this point, will be trained and mentored to successfully appear for Class X examinations in 2018. No child will be left behind." In principle, the Government aimed to achieve the following through this program:

- Building a strong foundation among all students in reading, writing, arithmetic, etc.  
Bridging the gap between current learning levels and the academic demands of their Class
- Focused practice and learning through worksheets

Under this scheme, students were divided into 3 sections in each grade; Pratibha, Nishtha and Vishwas. Pratibha or reader section comprises of students who are the talented as well as that those that are up to the level of the grade. Nishtha or non-reader section comprises of students who were unable to read and write the languages Hindi and English and also unable to solve Mathematical problems. They were those who have secured 33% in summative assessment 1 and 2 in the previous sessions (HT, August 24, 2016). Vishwas, another category comprises of students who have failed two times or have breaks/ drop outs during the tenure of their previous education. Students of grade IX are under special focus so that every student be able to pass X board exams by 2018. The division was done after a baseline assessment of the students which found that 74% out of 2,01,997 children in class 6 could not read a paragraph from their own Hindi textbook and 46% could not read a story of class 2 level. Sisodia, who was also in charge of the education department, said, "We conducted an assessment of our students... we found that 74 per cent of students can't read their text books, especially students of Class VI. And 46 per cent students of Class II are unable to read their books. We mapped every student. Our internal survey, as well as reports produced by the likes of ASER, found a large number of children cannot even read." (Indian Express, September 04, 2016).

ASER report is one of the key sources of initiating this scheme. Using some of ASER research strategies, baseline assessment was done. The Annual Status of Education Report (ASER) is the largest non-governmental household survey undertaken in rural India and is facilitated by the Pratham Education Foundation. 'ASER' means impact in Hindi. True to its meaning, the survey measures the enrolment status of children between 3-16 years and tests basic reading and arithmetic abilities of children through a detailed process that uses a common set of testing tools and a comprehensive sampling framework.

Dividing children was one aspect of the scheme. The intervention came with the new teaching strategies, shifting focus and introduction of "Pragati--I" books. The government described Pragati books as supplementary material which will help Nishtha groups read to understand syllabus of their class. These are thin books like workbooks provided for each subject. The books have one page of text explaining the lesson. For instance, science textbooks of class 6 have one page explaining the earth's rotation and revolution. A student generally learns about the earth when they are in class 2 or 3.

For the assessment Government planned two summative assessments SA1 and SA2. Following SA1, Parents Teachers Meeting was organized on August 29, 2016. It was a new experience to have PTM initiative in Government schools. The focus of the PTM was on sharing results of the first-term exams since the Government started the Chunauti 2018 scheme to improve learning levels and taking feedback from parents. For morning shift schools, the PTM was held between 8 a.m. to 1 p.m. and for the evening shift schools, it was held between 2 to 7 p.m. Teachers were also asked to brief the parents about NDP and show the answer sheets of students only if parents ask for it.

Government had even initiated another examination scheme wherein students who failed twice or more in Class IX, were provided the option of appearing for Class X exams through the Modified Patrachar Scheme of Examinations (MPSE). According to Delhi Government, the rationale behind MPSE was to ensure retention of children and to minimize the possibility of dropout. It is essential to point out here that students will appear in the class X examination directly (through the Patrachar Vidyalaya of the Directorate of Education, and not through the school). Alternatively, when students had failed Class 9 more than once, they will be provided the option of switching to another school close by, in order to escape the stigma that comes with repeatedly failing. These students also had the flexibility to drop subjects like Mathematics. On clearing class X exam

through PatracharVidyalaya, the children will be re-enrolled in regular XI standard in the same parent Government school as informed by Mr. Sisodiain various interviews.

The government had even set a deadline of November 14 to achieve 100 % learning ability.

Chunauti 2018 was planned in two phases; Chunauti 2016-17 and Chunauti 2017-18. Chunauti 2016-17 was a framework that was planned for a year. For the second phase i.e. Chunauti 2017, Circular number DE.23 (632)/Sch. Br./2017/493 has been circulated in the Government schools that again a baseline assessment would be done for the session 2017-18 for basic Hindi, English and Mathematics between April 3<sup>rd</sup> and 15<sup>th</sup>. Students will be assigned sections namely Pratibha, Nishtha and Nishtha Neo Readers on the basis of assessment for grade VI to VIII. Pratibha will be assigned to those who are at advance story level in Hindi, division level in Mathematics and story level in English. Students who are at word or below in Hindi, number recognition upto 99 or below and alphabet level or below in English would be a part of Nistha Neo Readers group. Rest of the students who come in between the two will placed in Nishtha. However, for grade IX after the baseline assessment students will be divided into Pratibha, Nishtha and Vishwas. Criteria for Pratibha group still remained the same. Rest of the students placed under Nishtha group and Vishwas group would comprise of students who couldn't clear class IX and are above 14 years of age or couldn't clear class IX exams for the second time.

Educationists had warned that Chunauti 2018 would have psychological effects. "The major issue with Chunauti is that children are being labeled and it also violates provision of the Right to Education Act. Children cannot be termed as slow learners by testing them on lesser known set of books. There are times when children cannot talk until they are two years old. But after that they speak entire lines fluently. This is the magic of development. But this kind of labelling is extremely dangerous and fascist," said Janaki Rajan, educationist and teacher at JamiaMiliaIslamia. (Hindustan Times, September 9, 2016).

## **OBJECTIVES OF THE RESEARCH**

- To study the opinion of parents (whose children study in Government Schools) regarding Chunauti 2018.
- To analyze the perspective of children who experience Chunauti 2018.
- To analyze the pedagogical implications of this policy in order to inform the assessment practices in schools.

## RESEARCH QUESTIONS

- What are the criteria-practices designed for ability grouping of students and to enhance the learning level in ‘Chanauti 2018’?
- How is the experience of children in schools after the implementation of chunauti 2018?
- What is the perspective of parents regarding Chunauti 2018 and its impact upon their ward?
- How is learning and experiences of students impacted after the implementation of Chunauti 2018?
- What are the pedagogical implications of this scheme for future references and to build policies?

## METHODOLOGY AND SAMPLE SIZE

Its a qualitative study. The modes of data collection were primarily semi-structured interview and content analysis. Sample was determined through snowballing.

### ➤ Semi-Structured Interview-

- Semi-structured interview was conducted with the children who have experienced Chunauti 2018 Scheme in their school in last one year. Hence, the children studying in Government schools in Delhi from VII-IX, became a part of the sample. Researcher selected 15 children residing in East Delhi through snowballing. This ensured multiple experiences from various set of Government schools rather than entire study based upon any particular school.

(I eliminated children who were in grade VI at the time of the data collection, because they had just started experiencing the practices implied under the scheme from that particular year unlike children from grade VI to IX, who had last year’s experience as well and were in a better position to reflect back and comment. This scheme is implemented in Government schools of Delhi from grade VI to IX.)

- Semi-structured interview were also conducted with the parents of these children, in order to get informed adult opinion about the impact of the scheme upon their ward.

## **RESEARCH ETHIC**

I eliminated school space as my research site as it might have lead to intrusion in the space and artificial responses of the participants, owing to their association with the school. Moreover, there were major issues regarding permission and dissemination of information. Willingness of the participants was the major criteria for the selection as it requires their thorough participation. Questions were sensitively framed.

## **LIMITATIONS OF THE STUDY**

This study is restricted to study the opinion of children who experience the schooling processes and parents who are vicariously in contact with schooling processes. Hence, the opinion of other stake holders is missing from the study. However, it is done intentionally.

## **ANALYSIS**

**Through the interview with the parents and majorly with children, researcher has sketched out a few themes that bring out the experience of the Chanauti Scheme. Even though these themes are overlapping at various points but these are meant to organize the data and present the analysis. The selection of themes is such that it brings forth commentary upon the aspects of Chanauti scheme as well as engages with some broader issues such as purpose of education. It enables the researcher to present the contextualized frame as well as perceive it in the broader picture.**

## **RHYTHM OF THE DAY**

A typical school for children under Chanauti Scheme involves a lot of hours devoted to studying. All the students reported studying as associative with school and it involved a process of transaction between the teacher and the students, wherein the teacher and the prescribed books became the directing unit. The major defining terms for expressing a typical school for the children encompassed these in addition to studies:- lunch break, sports and peers. These are the determining activities that define a school day for them. Even though sports period in many of the schools was limited to once a week and in many schools it has been curtailed to reach the aims as per Chanauti scheme. However, children define the school day using these parameters. So, activities such as assembly, teacher-student interaction outside the classroom which are a requisite for each day were not being dwelled upon by children but activities such as sports period, which is a weekly

phenomenon has more value in defining their school experience. Moreover, children also realized that one of the prime responsibilities of the school is to ensure safety of the children, hence the lack of sports period is a valid reason in order to avoid compromising on safety, even though they don't want this to happen.

*“As we have cemented floor and there is no sports teacher to take care of us. So, we don't have sports period. It is only during lunch that we play in this area and that too a caretaker keeps an eye on us.”* (Respondent)

A defining characteristic for school experience that comes out in the interview, even though few children have referred to it as such in defining a typical school day are 'peers'. However, they talked about it some form or the other, as a response to the various other questions. Peer relationship deeply impacts the nature of school experience as the peers formulate a core of their everyday engagements and any policy that restricts or alter their interpersonal relationship with the peers bound to affect them. The case of Chanuati scheme becomes really impactful as due to spacing out of children into ability groups (sections), it has molded the peer bonding. Children spend a lot of time with their friends in terms of sharing sitting space, scaffolding each other within the classroom and outside the classroom, during lunch break, prayer assembly and also on their way to and back from the school. This aspect has been discussed in detail in the next section on peer relationship.

Another dimension that comes to light is that elder sibling is very commonly seen as a source of teaching for children by the parents. In many households, they are entrusted with the job to help their younger siblings with studies and to update the parents regularly on the same. Many of them regularly interact with the tuition teacher in order to coordinate upon the studies. It is not that parents were unaware of the happenings at the school but in many cases, elder sibling had more knowledge in terms of their everyday happenings and impactful incidents such as fight with the a close friend, etc. It can also be attributed to the age group to which these respondents belonged to i.e from 12- 16. They are adolescents and one of the attribute of this stage is secretiveness as they tend to experience a lot in their personal relationships which they are at times not comfortable sharing with the adults (parents in this case).

*“He doesn't tell me much about his school. He talks about the school with his brother and sister as they all are in same school. And that too mostly with his brother.”* (Respondent)

Hence, this reflects that studies have been a consistent feature during this phase of Chanuati scheme. However, one point to ponder is that it is equally important that activities such as sports,

which hold so much meaning for children must not be impacted by the efforts to reach the aim of any government policy/scheme. These activities impact experience of schooling much more than we consider. Peers and siblings also have an impactful role in the rhythm of the day.

## **RELATIONSHIP WITH THE PEERS AND FRIENDS**

Peer relationship is one of the core elements that define a school experience as mentioned above. It was also confirmed through the interviews as all the respondents talked about it as an answer to one question or the other. Some dwelled upon it deeper and some made a passing reference but it was an aspect that was reflected in the interview with each of the respondents.

Some (5 respondents) children had their majority of friends still in the same section and their segregation into different ability group hasn't impacted their friendship at all.

*"Most of my friends are still in my section. So the different sections haven't impacted my friendship."* (Respondent)

The likely reason that can be attributed to it is that students' grouping is also determined to an extent by teacher's assessment of their abilities. Teacher's notions regarding their academic performance tend to impact their friendships and make them comfortable with some children more than others. However, this hypothesis is a possibility and assertion of the same would require a longer period of engagement on this aspect itself. The other possibility is that not many students of a certain section were shifted during the ability grouping, thereby not impacting the grouping much. It might have been the case for one or two schools but it is very less likely to be the case with all of them.

Another aspect that came to light is that the interaction patterns are quite gendered. Many of the respondents tend to exclude the other sex from their defining circle of friendship. This can be attributed to their understanding of suitable form of interaction. Keeping up with their internalized understanding of expected performance activity, they act accordingly. For example many of the girls mentioned that they like talking to their friends about their problems, everyday happenings and personal life whenever they get time. Instead, boys said that whenever they get time in the school, they usually prefer to play. The reason behind gendered forms of interactions can also be traced to the guidance they receive from their teachers in addition to socializing forces outside the school. Boys and girls are encouraged to maintain 'distance' as the term used by one of the respondent suggests. Here 'distance' refers to physical separation i.e. boys and girls, not sharing same desk, different lines during assembly and also limiting one's interaction with the other sex is



seen as advisable. Burger points out, “The child does not internalize the world of his significant others as one of many possible worlds... It is for this reason that the world internalized in primary socialization is so much more firmly entrenched in consciousness than worlds internalized in secondary socialization.... Secondary socialization is the internalization of institutional or institution-based ‘sub worlds’... The roles of secondary socialization carry a high degree of anonymity... The same knowledge taught by one teacher could also be taught by another... The institutional distribution of tasks between primary and secondary socialization varies with the complexity of the social distribution of knowledge” (1999; 149)

*“Teacher counseled them all to maintain distances from the other sex because they are in the growing up age and should maintain proper conduct rather than talk too much to each other. ....We have separate lines for girls and boys during prayer time also.”* (Respondent)

It also came to light that being in the same class doesn’t ensure friendship. Of course being in the same section gives more avenues for interaction. Other overlapping categories such as place of residence, common friends enhance the possibilities for friendship.

*“I go to elder students of class 9-10 during lunch as I like to be with them. And during sports period I play with my class friends or go to my other friends (here the other friends are the ones who live near the house but are in different sections.”* (Respondent)

Children’s responses also highlighted that their friendship has been affected. Respondents pointed out that the studies have gone better (better here means more focused, stricter and constant checks on performances) but it also reflected that children have formulated an understanding of each other based on ability group and these are limiting their interaction pattern in the prejudiced ways.

*“But after coming to this section I have made a new friend named Rupa. I don't be with them here that much because my old friends get angry that I spend too much time with the new ones and don't give them time. I like everything about my friends- old or new, because of I don't like anything they are not my friends.”* (Respondent)

*“My friends have been separated. We were 5 friends now we 2 are left. This year we got separated. When they got in Pratibha group and we got into this (Nistha) group.”* (Another respondent)

*“I don't like the pratibha group's children. They are arrogant about their marks and their studies. I was in vishwas and then I came to nishtha but the pratibha group is very arrogant..... And*



*because of having good marks the pratibha group children are thought to be superior and they take themselves as superiors as well.” (Another respondent)*

*“I have 12 friends. We play, study and eat together. They also like maths but now they are in pratibha group or in different section, so I have to meet them after dispersal or sometimes during the recess. And because we all have our pending work to do, so most of the times we are completing it and don't have time to meet each other. Many a times, they get angry.” (Another respondent)*

The above responses are shown to reflect the impact on their friendship and also the notions about the other ability groups.

Now, I would like to dwell a little deeper into the notions that children have formulated about peers from different ability groups under Chanuati scheme. Many of those from Nistha and Vishwas pointed out that those who are in Pratibhagroup are oversmart and don't talk properly. There is a possibility that they are trying to act out their assumptions and thereby reinforcing them as not all can ever be clubbed because of having similar behaviour attributes. However, this comes out as a common perception prevalent among those of Nistha and Vishwas group, so the possible rationale is that there are limited avenues for interaction for students from the same class (not same section) in terms of time available, which allows one person to know the other. There also seem to be an internalised understanding of oneself which is reflective of one's academic profile i.e. the marks they score and teacher's notion of them.

*“Vishwas group is taught the "barakhadi", so yes, there is a difference. Everyone should be taught in different ways in my opinion and help should be given in the areas they lack. Pratibha group is taught in the best way. The teachers treat all groups differently.” (Respondent)*

The reinforcing factor of difference is that children understand that they are being taught different content using differential pedagogic technique.

Hence, peer relationship has its dynamics of operationalization. However, this is certain that the peer relationship and friendships were impacted due to the understanding of rationale behind ability grouping and the segregation of children. Some children are still trying to negotiate in terms of peer bonding.

## SUBJECT MATTER, CHOICE AND PEDAGOGY

There is a variety in terms of subjects that children like and dislike from each of the sections. Rare is the case of same subject being liked or disliked due to similar reasons which restricts one from drawing possible inference, explanative of Chanauti scheme.

Hindi is a subject that children are very comfortable with and none said that they didn't like Hindi. Hindi is one of the target language upon which Chanauti scheme works upon. However, if we talk about English, then an aspiration to learn the language is quite visible. Majority of the responding children aspire to excel in this particular subject and be able to fluently use this language. When asked about the pedagogy of these, then more individual specific responses were achieved rather than any feedback on the scheme and the way it plans to tackle both these languages as subjects.

*"Science teacher. She explains in the best way possible and each and every word."* (Respondent)  
She said that science is explained to them in Hindi by the teacher so that they get every concept.

*"Maths should be taught better, because she doesn't explain anything but just asks us to see the examples and solve the exercise like that on our own."* (Another respondent)

*"I like English very much because i want to learn it and I like to converse in English."* (Another respondent)

Another aspect to point out is that children generally attribute their liking of the subject to the way it is taught in the class. However, it is essential to point out that these pedagogic forms may not be the best suitable forms to grasp that language. For example for the teaching of English, Position Paper National Focus Group on the Teaching of English, NCERT, points out that translations are not a suitable way to teach English (2006; 13). It doesn't in any way help children use the language fluently and most of the children tend to use translations as a way for dealing with the language in future. This is attributed to the teacher education programmes, not being able to develop a pedagogic technique. ShaliniAdvani (2003) in her ethnography on teaching of English has also talked about similar patterns being observed. She highlights how the teachers who are themselves struggling with this language impose their understanding upon children.

*"And I don't like Sanskrit because it's too hard to even understand. English teacher explains very well. And does every word's Hindi translation."* (Respondent)

Children also perceived that Pratibha group children were taught in the best possible way with lot of dedication and effort.

Hence, the choice of subject matter is certainly impacted by the teacher and her pedagogic technique. This seems to be more individual governed rather than impacted broadly by the policy. Moreover, students' liking for a particular subject matter doesn't necessarily mean it is taught through a suitable pedagogic form/ technique.

## **PERSPECTIVE ON TEACHERS**

As pointed out in the last section, teachers seem to have quite a dominant force as far as liking or dislike for any subject is concerned. Another common feature pertaining to teachers that came across in the responses of a lot of children is that teachers are perceived as biased by children. Here biased refers to making some relaxations in rules, being more sympathetic and being appreciative of some than the others. Academic performance is one major reason attributed to this biasness and other being behavioral components, such as sincerity and diligence.

*"She seems to be biased towards the students who are better in studies. I don't feel good about it. She should talk to us in the same manner and help us in doing better. Within the class itself there are some children who are the favorite of the teachers."*(Respondent)

2 respondents from Vishwas group pointed out that teachers don't like coming to their section which is reflected in their actions such as holding head in frustration and many a times teachers even spell it out.

*"Teachers don't like coming to their section and behave as if punishment is given to them. They hold their head due to frustration and it is often because many children in my group don't study at all, their copies are often incomplete, etc."* (Respondent)

Hence to say that teachers' attitude towards children gets communicated to them through verbal and non-verbal gestures would not be wrong. Hence, as a researcher one could say that in order to make such policies work out in best possible way, it is required that proper orientation session for teachers should be organized. Otherwise, several unsuitable messages get communicated to children. Moreover, here it would be equally important to assert that care must be taken that teachers do not feel burdened; otherwise it gets directed towards children which ought to bring negative impact upon them.

## EXAMINATION

Students conveyed that exams are conducted thrice in a year and additional tests for 2-3 times. Students had clarity that three different kinds of question papers were given to them as per the ability group to which they belonged. They knew as that the examination papers differ in their level of difficulty; thereby differential time was allocated for each group to attempt the paper. Some of them said that the paper given to Pratibha group is the longest and the 'hardest'. Here 'hardest' refers to being conceptually at an advanced level. Majority of them believed that rightly different papers should be given as per their ability level. Hence, rarely did any of the child questioned the judgment of their ability and segregation by the teacher.

There have been some major changes as recounted by the children and parents during the interviews. One point that has come across is that the level of seriousness has increased. For defining seriousness, multiple characteristics were mentioned such as regularity of teachers in coming to school and taking the classes, a lot of repetition of the content and making many more attempts to help students to learn and understand. However, the nature of these attempts would require closer examination. For example one of the Vishwas group student mentioned that he was asked to learn the text content by heart after it was read aloud in the class. This may not be in best interest of the child when it comes to helping him learn to read but given the time frame and constant checks upon the teacher as well, this could have been a possible way.

*"Earlier teachers used to come very late to the class and schools but now the teachers come on time and the teaching-learning happens daily."* (Respondent)

*"She has become quite serious. Other day she started crying at night because she needed a new register, which teacher had asked them to get. Then her brother went and got the register. She keeps her notebook very neat and tidy."* (Respondent)

There seems to be a mixed reaction when it comes to the opinion of the child regarding the scheme. Some of them seem very satisfied and this level of satisfaction was more amongst the children from Pratibha group as compared to other groups. In a few cases, it was also seen as a source of motivation to get shifted from Nishtha to Pratibha. Some of them seem to be disturbed and disheartened by being in a particular section and to deal with constant labeling and checks. This was more common with the children of Vishwas group.

*"Question paper is different for groups. Pratibha has to do more questions and Nishtha less. I would have done Pratibha group's paper, because it has more questions so I would get more*

*marks on solving and answering them. Question papers should be different for everyone according to their level.” (Respondent)*

Few of them felt frustrated and additional pressure upon them. The reason given for it is that every day they are made to work upon the areas which were considered by the teacher as requiring improvement and a close check was kept upon them. This made them feel a little pressurized as in addition to class work, home work had increased and regularly tracked the teacher. This has also lead to regular work being done in the notebooks and close attention has ensured that the notebooks are tidy and proper. 2 of the parents listed it as a marker of improvement as these are some of the defining characteristics of quality of education for parents.

Others pointed out that their ward’s attendance is closely monitored and if he/she is absent for more than a week than they are called at school to answer for the same. This was not a common occurrence prior to the implementation of the scheme. 3 parents pointed out that the school building has improved a lot owing to the scheme, particularly the school ground. This lead to both dissatisfaction as well satisfaction amongst the parents. 1 perceived it as a marker of improvement and 2 perceived it as a wastage of time and effort to decorative aspect rather than improving quality of education. It is important to point out here that the wards of both of these were in Vishwas group.

Hence, it seems that exams hold a lot of meaning for children. Differential nature of examination paper is being accepted by the majority. However, overall level of dissatisfaction seems more amongst Vishwas group children and their parent. The shifting from one group to other based on examination is quite a motivation when done in schools.

## **PURPOSE OF EDUCATION**

In all the interviews the purpose of the education is perceived by children as well as parents, as a means to achieve better forms of capital in order to improve one’s economic condition. Hence, the futuristic aspect of education is quite a popular notion and this is the only notion that came across when asked about the need and purpose of the education they are receiving. Children concretized it in the forms, such as to get better job (quite a common answer), be richer, etc.

“If I become something in future I would be able to support my family financially and the conditions would be better.”

“To make our future and earn money.”

“Education is the way I can fulfill my dream to be policeman.”

We all understand that the futuristic aspect of education has a dominance for its potential to improve and make the life better but making life better doesn't necessarily mean perceiving it in terms of the future. Equally important is its role in the present of an individual in giving it an outlook, exposure and perspective to understand the world around. Hence, it is required that through each policy framework. It is quite a serious concern as education more or less gets concretized in terms of competition and rat race.

This has direct link to how children and parents perceived the various tenants of the policy. Nowhere did children or parent said that due to the seriousness and the way policy is implemented, there is an enhancement level in functional literacy which the child has been struggling with for long. ASER reports have repeatedly shown a great lag in the level of functional literacy and expected performance as per the grade. None of the children expressed joy for being able to read on their own, rather comparative aspects seems quite highlighted in the statements by children as well as their parents, which leads to dissociation from the issue and the larger issue of dissatisfaction. This is something that we can keep in mind when we come up new policy frames to tackle with such grave issues; for being misfit in the class due to lack of content knowledge required to be able to cater to the current course content.

I have eliminated the section on PTM from this article. As a researcher it was quite a challenging process for me to frame my questions in a manner that they don't point out any aspect and still be able to help me uncover the layers of Chanauti Scheme. Asking direct questions would have meant a conscious selection of words by respondents and fabrication of responses. Till the point I entered the field, I was unsure if the responses of the respondents would lead me towards the objective or not. However, it did. Some aspects in the responses were so common that they surprised me and the discussion with the mentors helped me understand the gravity of its impact. I would like to thank the organisation Child Rights and You for giving me the opportunity to work upon the area of my interest and the mentors Prof.Ravinder Kaur (Professor, IIT Delhi), especially Dr.Neelam Sukhramani (Associate Professor, Jamia Milia Islamia) and Ms. Komal Ganotra (Director, Policy and Advocacy for CRY) for the guidance and enriching the experience which was not limited to this research study but beyond it. Some of the discussions with them made me reflect upon the areas way beyond the capacity of this research. Hence, it was a personal journey of growth and learning, being mentored.

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# SHORTEST PATH ALGORITHMS: COMPARISON AND APPLICATIONS

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## **ABSTRACT**

*In graph theory, the shortest path problem is one of the most classical problems aiming to find the shortest path between two nodes in a network. This survey paper aims to present five basic algorithms and compare them theoretically by analysing time complexity. The paper discusses their performance and summarises the shortest path algorithm's best application range, followed by their applications.*

**Keywords:** Shortest path algorithm, single source shortest path, multi source shortest path, spanning tree

**AMS Subject Classification (2010):** 97K30, 05C85, 94C15

## **1. INTRODUCTION**

Discrete Mathematics is the branch of mathematics that deals with objects that are discrete values. It is often used in contrast to the "Continuous Mathematics" which is the branch of mathematics that deals with the objects that vary smoothly (for example: calculus). Discrete Mathematics further comprises of combinatorics, set theory, number theory, graph theory, probability, etc.

Graph theory may be considered as the branch of Discrete Mathematics that deals with networks of points that are connected by lines. The subject of graph theory had its beginnings in recreational mathematical problems, but has grown into a significant area of mathematical research, with applications in chemistry, operational research, social sciences, and computer science. The history of graph theory may be specifically traced to 1735, when the Swiss mathematician Leonhard Euler solved the Königsberg bridge problem. The Königsberg bridge problem was an old puzzle concerning the possibility of finding a path over every one of seven bridges that span a forked river flowing past an island but without crossing any bridge twice. Euler argued that no such path exists. His proof involved only



references to the physical arrangement of the bridges, but essentially, he proved the first theorem in graph theory. Generally, a graph consists of vertices which are connected by edges. Graphs are further divided into directed graphs, undirected graphs and mixed graphs.

Shortest path problem is a well-known problem in graph theory, in which a path between nodes or vertices is calculated in such a way that the sum of weights of its constituent edges is minimised. According to the final node and the characteristics of the path, the shortest path problem can be divided into five types: the shortest path between two nodes, the shortest path among all nodes, the K shortest path, the real time shortest path and the shortest path of a specified path. Shortest path is an important research topic in graph theory. Massive domestic and foreign scholars discussed it deeply and proposed diverse algorithms to solve shortest path problems.

Shortest path algorithm is a kind of searing algorithm of calculator graphics, which means searching the lowest cost path between the starting point and the object point. There are two categories of shortest path algorithms: setting algorithms and correcting algorithms. The shortest path is divided into single source shortest path and multi source shortest path. Single source shortest path is getting the shortest path from a given vertex to any other vertex. The classical single source shortest path algorithm viz., Dijkstra's algorithm, which was conceived by computer scientist Edsger W. Dijkstra in 1956 (Dijkstra, 1956 ; Kong, 2011), is used in road networks. Richard Bellman (Bellman, 1958) and Lester Ford (Ford, 1956) published the Bellman-Ford algorithm in 1958 and 1956 respectively (Hougardy 2010), which differ significantly from Dijkstra's algorithm as it can be used on graphs with negative edge weights as long as the graph contains no negative cycle reachable from the source vertex. In 1930, Czech mathematician, Vojtěch Jarník developed an algorithm which was rediscovered and republished by computer scientist Robert C. Prim in 1957 (Prim, 1957; Gitonga, 2015) and Edsger W. Dijkstra in 1959 (Dijkstra, 1956). Therefore, it is known as Prim-Dijkstra algorithm which is used to find a minimum spanning tree for weighted undirected graphs.

Another algorithm known as Kruskal's algorithm published by Joseph Kruskal in 1956 (Kruskal, 1956, Erniyati, 2019) is also used to find a minimum

spanning tree for a connected weighted graph adding increasing cost arcs at each step. In 1962, the Floyd-Warshall algorithm could find shortest paths in a weighted graph with positive or negative edge weight, which is a typical multi source shortest path algorithm.

A greedy algorithm is an algorithm that follows the problem solving heuristic of making the locally optimal choice at each stage (Black,1998). This algorithm is used for optimization problems. In many problems, a greedy strategy does not usually produce an optimal solution but makes the best choice at every step and attempts to find the optimal solution to solve the whole problem. For example, the travelling salesman problem is the following heuristic: "At each step of the journey, visit the nearest unvisited city". This heuristic does not intend to find a best solution, but it terminates in a reasonable number of steps thus it helps in finding an optimal solution to such a complex problem. Kruskal's algorithm and Prim's algorithm are the greedy algorithms since they produce a minimum weight spanning tree at each stage giving an optimal solution. As far as the history of greedy algorithms is concerned greedy algorithms were conceptualized for many graph walk algorithms in the 1950's. Edsger Dijkstra conceptualized the algorithm to generate minimal spanning trees. He aimed to shorten the span of routes within the Dutch capital, Amsterdam. In the same decade, Prim and Kruskal achieved optimization strategies that were based on minimizing path costs along weighed routes. In the 1970's, American researchers, Cormen, Rivest, and Stein proposed a recursive sub structuring of greedy solutions in their book "Classical introduction to algorithms". The greedy search paradigm was registered as a different type of optimization strategy in the NIST records in 2005. Till date, protocols that run the web, such as the Open Shortest Path First (OSPF) and many other network packet switching protocols use the greedy strategy to minimize time spent on a network.

In this survey paper, Section 2 gives basic definitions of graph theory. Section 3 presents five shortest path algorithms. Section 4 compares the performance of these algorithms, followed by a discussion of their applications in Section 5. The paper is concluded in Section 6.

## 2. PRELIMINARIES

A **graph** is a mathematical representation of a network that consists of lines and points. A graph is denoted by  $G$ , where  $G$  is an ordered pair written as  $G=(V, E)$ , where  $V$  is a non-empty set of points or **vertices**, and  $E$  is the set of lines or **edges** in  $G$ . A **subgraph** is a graph where the vertex set and the edge set is a subset of the vertex and edge set of  $G$  i.e. a subset of  $G$ . The **degree** of a vertex is defined as the number of edges connected to a vertex. A **loop** is an edge whose initial and terminal vertex is the same. In **multiple edges**, two or more edges lie in between two vertices (see Figure 4). A **simple graph** is an undirected graph that does not contain any loops and multiple edges (see Figure 2). A **pseudograph** (directed/undirected) is a graph with loops and multiple edges (see Figure 4). A **walk** is a pseudograph in which we have an alternating sequence of vertices and edges beginning and ending with a vertex, in which each vertex except for the last vertex is incident with the edge which follows, and the last vertex is incident with the edge which precedes it. A **closed walk** is a walk where the length of the walk is greater than zero i.e. at least one edge should be there, and the first and last vertex is the same. A **path** is a walk in which all vertices and edges are distinct. A **trail** is a walk in which all edges are distinct, and vertices may or may not repeat. A **circuit** is a closed walk where vertices may repeat, but edges are not allowed to repeat. A **cycle** is a circuit where the first vertex appears exactly twice (at the beginning and the end), and no other vertex appears more than once. Table 1 explains definitions of a walk, path, trail, circuit and cycle with examples. **Two edges** in a graph are called **adjacent** if they share a common vertex. **Two vertices** are said to be **adjacent** if they share a common edge. A graph with only one vertex and no edges is called a **trivial graph**. A graph with only vertices and no edges is known as an **edgeless graph**. The graph with no vertices and no edges is sometimes called the **null graph** or **empty graph**. A **finite graph** is a graph where the vertex set and the edge set is finite; otherwise, the graph is called an **infinite graph** (see Figure 3). A **directed graph** is a graph where the edges have some orientation or direction (see Figure 1). In an A **directed graph**, the edges do not have a direction (see Figure 2). A **mixed graph** is a graph that is both directed and undirected. A **weighted graph** is a graph having weight or numbers associated with each edge (see Figure 5). An **acyclic graph** is a graph where there are no cycles. A **tree** is an undirected acyclic graph. A **forest** is an undirected graph in which any two vertices are connected by at most one path, or equivalently; it is an undirected acyclic

graph (see Figure 4). A **spanning tree** is a connected graph and a subgraph that includes every vertex of  $G$ , while the **minimum spanning tree** of a weighted graph is a spanning tree of the least weight.

In this section, we shall focus on two areas, single source shortest path and shortest path among all vertices. We will study five shortest path algorithms viz., Improved Dijkstra's algorithm, Bellman-Ford algorithm, Floyd-Warshall algorithm, Kruskal's algorithm and Prim's algorithm.

### 3.1. IMPROVED DIJKSTRA'S ALGORITHM

The Dijkstra's algorithm is used to find a single node as the source node and calculate the shortest paths from the source to all other nodes in the graph, increasing node by node to get a shortest path tree. The algorithm is as follows:

Step1: Begin with  $D[i]$ .  $D[i]$  represents the distance from the starting point  $V$  to the point  $V_i$ . If there is an arc between the two vertices, then  $D[i]$  is the weight of the arc; Otherwise, consider  $D[i]=\infty$ .

Step2: Find a node  $V_j$ , which is adjacent to node  $V$  and has the shortest distance from  $V$ .

Step3: Then find a node  $V_k$ , which is adjacent to node  $V_j$  and has the shortest distance from  $V_j$ . Make  $D[j]=\text{Min}\{D[j], D[i] + \text{the weight from } V_j \text{ to } V_k\}$ .

Step4: Repeat the Step3 until the destination node is reached.

Figure 6 [16] and Table 2 [16] show the steps of the algorithm in detail.

### 3.2. BELLMAN-FORD ALGORITHM

The Bellman-Ford algorithm is an algorithm that computes the shortest path from a single source vertex to all of the other vertices. It is capable of solving graphs in which some of the edge weights are negative numbers. The algorithm is as follows:

Step1: Start with  $D[i]$ .  $D[i]$  represents the distance from the starting point  $V$  to the object point  $V_i$ . Step2: Consider  $w(m,n)$ , it is the weight of the edge  $e(m,n)$ , and  $e$  is the shortest path between  $(m,n)$ . For each edge  $e(m,n)$ , if  $D[m] + w(m, n) < D[n]$ , then  $D[n] = D[m] + w(u, v)$ .

Step3: The loop performs up to  $i - 1$  times, and  $i$  is the number of the vertices. If the operation above does not update the  $D[i]$ , the shortest path has been searched, or some of the points cannot be reached. Otherwise, execute the next cycle.

Step4: Test the diagram to find whether it has a negative loop (the sum of weight is less than 0). If  $D[u] + w(u, v) < \text{Distance}[v]$ , there is a negative loop, which means the shortest path cannot be found in the graph. Otherwise,  $D[i]$  records the shortest path.

For example, if there is a negative loop, the value of each point will decrease, after one traversal. It is shown in the Figure 7 (Hougardy, 2010).

### 3.3. FLOYD-WARSHALL ALGORITHM

The Floyd-Warshall algorithm compares all possible paths through the graph between each pair of vertices, namely, it calculates the shortest path between all nodes. The basic idea of the algorithm has four steps:

Step1: Find two vertices from the network, put each vertex in the network into these two points as an intermediate.

Step2: Compare the original distance with the new distance between these two points, treat the smaller distance as the new shortest distance.

Step3: Sequentially construct  $n$  matrix  $S(1), S(2), \dots, S(n)$  by looping iteration, the each element in the last matrix  $S(n)$  represents the shortest distance between the two points.

Step4: Get the minimum distance of one point to the other points by summing the elements in each lines of  $S(n)$ , one or more best locations can be found by comparing these summations. The Figure 8 (Li et al, 2008) and Table 3 (Li et al, 2008) explain the algorithm in detail.

### 3.4. KRUSKAL'S ALGORITHM

The Kruskal's algorithm is a greedy algorithm which finds Minimum Spanning Tree (MST) to connect each tree in a forest (Kusmira and Rochman 2017). It is applicable for undirected weighted graph. A tree is an undirected graph which is connected and does not contain cycles. A tree with  $n$  vertices must have  $|n-1|$  edges.

Figure 9 (Erniyati, 2019) illustrates several examples to distinguish graphs which are trees and which are not. The graphs  $G_1$  and  $G_2$  are trees since it is connected that is there is a path from any point to any other point in the graph and there is no cycle. The graphs  $G_3$  and  $G_4$  are not trees as  $G_4$  is not a connected graph and in  $G_3$  a cycle namely adf is present.

A Spanning tree of a connected graph  $G$  is a subgraph which is tree and includes every vertex of  $G$  and a Minimum Spanning Tree of a weighted graph is a spanning tree of least weight.

The Figure 10 (Erniyati, 2019) explains that  $G_5$  is a graph and  $T_1, T_2, T_3, T_4$ , are the corresponding spanning trees.

The algorithm is as follows:

Step1: Remove the loops and parallel edges in the graph if any while keeping the edges with minimum weight.

Step2: List all the edges and sort them in the ascending order.

Step3: Take the edge with the least weight and use it to connect the vertices of graph. If adding an edge creates a cycle, then reject that edge and go for the next least weight edge.

Step4: Keep adding edges until all the vertices are connected and a Minimum Spanning Tree (MST) is obtained.

An example of Kruskal's algorithm where Erniyati, P citra (Erniyati, 2019) found shortest path to a building is presented in Figure 11 (Erniyati, 2019). Graph data with distance between vertices and after they are arranged in ascending order is shown in Table 4 and Table 5, respectively (Erniyati, 2019).

After applying the steps of Kruskal's algorithm Figure 12 (Erniyati, 2019) shows the shortest path.

### 3.5. PRIM'S ALGORITHM

The Prim's algorithm is another greedy algorithm which finds Minimum Spanning Tree to connect each tree in a forest (Kusmira and Rochman, 2017). It is applicable for weighted undirected graph. The algorithm is as follows:

Step1: Take any arbitrary vertex.

Step2: Find all the edges that are incident from the chosen vertex in Step 1 and choose the one with minimum weight.

Step3: Add the above chosen edge and vertex in the minimum spanning tree.

Step4: Keep repeating Step 2 until we get a minimum spanning tree.

Step5: Stop when there are  $|n-1|$  edges.

For example, if we have to connect a set of buildings by a fibre network then it is connected if and only if there is an unbroken chain of fibre links between every two buildings in a set (Gitonga, 2015).

Prim's algorithm can reduce the overall costs during interconnection of buildings to the existing local area network.

The Figure 13 is the aerial map of the Chuka University as discussed by Charles k.gitonga (Gitonga, 2015), main campus with the main buildings visible where: 1) Science tuition block, 2) Library, 3) Business complex, 4) Dispensary, 5) Media studio, 6) Ladies hostel, 7) University pavilion, 8) Students business and recreation centre, 9) ICT centre, 10) Students finance, 11) Model school

The Figure 14 (Gitonga, 2015) shows the existing network of Chuka University. It is evident that this current network is leading to wastage of cable used thus, resulting in wastage of money.

Table 6 shows the relative distance to ICT in meters. After applying Prim's algorithm, Figure 15 shows the new fibre network connecting the buildings where it is evident that the amount of cable used now has significantly reduced (Gitonga, 2015).

#### **4. COMPARISON OF FIVE ALGORITHMS**

In this section we compare the five shortest path algorithms that have been discussed in section 3. Both Dijkstra's algorithm and Bellman-Ford algorithm use the method of relaxation calculation, which is to find the shortest path by modifying the values of  $D[i]$  during the process of traversing the vertices and edges of the graph. The Dijkstra's algorithm is mainly aimed at the graph with nonnegative weight nodes, while the Bellman-Ford algorithm can deal with the shortest path problem with negative weights. They are used to draw the optimal solution of the shortest path, but the Bellman-Ford algorithm has huge redundancy and lower efficiency.

The Dijkstra's algorithm can only be used in single source shortest path problem. But the Floyd-Warshall algorithm can be used to find the shortest path between any two points. It is suitable for finding the shortest path among all vertices or in a small data scope. The Prim's algorithm and Kruskal's algorithm are also similar in some place. Both of them are greedy algorithm and find the minimum spanning tree and they also work if the weights of the edges are negative.

The Prim's algorithm starts to build the minimum spanning tree from any vertex in the graph while the Kruskal's algorithm starts from the vertex carrying minimum weight in the graph. In Prim's algorithm, it traverses one node more than once to get the minimum distance while Kruskal's algorithm traverses one node only once. Prim's algorithm works only for connected graphs but Kruskal's algorithm works for both connected and disconnected graphs. Prim's algorithm has a time complexity of  $O(n^2)$  but it can be improved to  $O(m + \log n)$  using Fibonacci heaps while for Kruskal's algorithm it is  $O(m \log n)$  where  $n$  is the no. of vertices and  $m$  is the no. of edges. The advantages and disadvantages of an algorithm are mainly measured from two aspects: the execution time of the algorithm and the storage space. Prim's algorithm runs faster in dense graphs while Kruskal's algorithm runs faster in sparse graphs. Also, the Kruskal's algorithm and Prim's algorithm fail in directed graphs since in Prim's algorithm, it assumes that the graph is connected but it is not necessary that every node is reachable from every other node. While in Kruskal's algorithm, we check every time if a cycle is formed or not but in directed graphs the algorithm fails to detect the cycles.

#### **5. APPLICATIONS**

##### **5.1. Solving Flight Radius Problem**



The main idea of the Flight Radius Problem is to locate the network passing through a specific flight, and represent business opportunities that are attractive to the passengers according to different preferences. The Flight Radius Problem is formulated as a problem of finding a maximal subgraph in terms of nodes. The problem can be solved using the shortest path algorithms to find the maximal subgraph of the graph.

There are two categories of shortest path algorithms: setting algorithms and correcting algorithms, which are used to solve the Flight Radius Problem. Dijkstra's algorithm is the most known setting algorithm and works with positive weight arcs. In Dijkstra's algorithm, the principle is to select a node with the minimum weight at each iteration, and then each node is scanned at most once. This leads to a complexity of  $O(n^2)$  as time bound in the worst case (Ahuja et al., 1993) where  $n$  is the number of nodes. There are many versions of Dijkstra's algorithm with the aim of improving this time bound by trying different data structures and several implementations of the algorithm (Ahuja et al., 1993). In some applications of the shortest path problem, we want uniquely to determine the shortest path between two nodes. Bidirectional Dijkstra's algorithm solves the problem of finding the shortest path between two nodes faster than Dijkstra's algorithm since it eliminates some unnecessary computations. Besides, Bellman-Ford-Moore algorithm which is known as a correcting shortest path algorithm is also used as it achieves the best currently known bound of time with negative weight arcs  $O(nm)$  where  $m$  is the number of edges. The algorithm maintains the set of labelled nodes in a

FIFO queue and allows detecting negative cycle in a weighted directed graph. Unlike Dijkstra's algorithms where we need to find minimum value of all vertices, in Bellman-Ford algorithm, arcs are considered one by one. The next node to be scanned is removed from the head of the queue; a node that becomes labelled is added to the tail of the queue. The algorithm performs at most  $n-1$  passes through arcs. Since each pass requires  $O(1)$  computations for each arc, this conclusion implies  $O(nm)$  time bound for the algorithm.

## **5.2. Maze Solving Problem**

The most important task for maze solving problem is the fast and reliable finding of its shortest path from its initial point to its final destination point.

For solving the maze and finding the shortest path between the starting and end points, three types of graph theory algorithms are implemented and their results are compared in order to select the best one. Breadth First Search, Best First Search and A\* algorithms are implemented and tested on different simple and complex mazes and their results are compared based on the required solving time and the resulted path length from each method. The goal of this comparison is to select the best algorithm that can provide the shortest path with the least time in order to be implemented in this proposed maze-solving robotic system.

Breadth First Search is an algorithm for searching graph data structures. It can be used for searching the maze cells or nodes. The job of this algorithm is to reach the goal cell from the starting cell. It starts at starting cell of the maze and explores the neighbour cells first before moving to the next level neighbours. It uses cost storage to determine the order of cells visited as shown in Figure 16 (Kern 2000) and keeps records of which cell are immediate neighbours of starting cell. Starting cell is labelled as (0). The algorithm expands cells in order of their distance from the starting cell, generating one level of the tree at a time. It traverses the tree by layer through creating a list of nodes/cells to traverse and adding the children of each node in the list at the end of the generated list. This cell expanding continues until finding the goal or the end cell. By this way, the Breadth First Search can find the shortest path to the goal cell and the time required to find this path is proportional to the number of cells generated as each cell can be generated in constant time.

A\* is a search algorithm that can be used in path-finding problem. A\* searches among all possible maze paths from start point to end point in order to find the path that needs the smallest cost according to the Equation (1) (Kern 2000):

$$f(n) = g(n) + h(n) \quad (1)$$

where n is the last node on the path, h(n) is the distances to each node from the goal node and g(n) is the path cost from start node to n. A\* starts from a specific node of a graph and constructs a tree of paths starting from that node. It keeps expanding paths one step at a time by taking the node with least value of evaluation function f(n), until one of its paths ends at the predetermined goal node. Figure 17 (Kern 2000) illustrates the A\* algorithm.

Best First Search algorithm can also be used for path finding problem. To find the best path to the target destination node, at each node of the graph it evaluates which node to be expanded

next based on the lowest cost using evaluation function which measures the distance from the node in concern to the goal as shown in Figure 18 (Kern 2000). The graph theory algorithms are applied on the binary image of maze to find the shortest solution path between starting point and end point.

### **5.3. Shortest Path to the Building Store in the City of Bogor**

The purpose of this problem is to find the shortest path to a store in Bogor. The Kruskal's algorithm is one of the algorithms used to solve minimum spanning tree problems by choosing the edge with the least weight and the edges that are selected cannot form a closed loop. Erniyati, P citra (Erniyati, 2019) used data activities controlled by land transportation from PT.TA. The results showed that Kruskal's algorithm is used in finding the nearest route to a building store for shipping goods and an optimal path is obtained. The city of Bogor is one of the cities with many trajectories or lanes so delivering goods would require a lot of time and cost. To determine the closest path to the location of a building store in the city of Bogor, Indonesia, the data where 's' is the starting point in Kranggan No.100 Keranggan Road, GunungPutri, Bogor to 12 store locations with several nodes is shown in Figure 19 (Erniyati, 2019).

As discussed in section 3.4, in order to get the shortest path to the building we write the graph data consisting of the list with distance between the vertices, further arranging the list in ascending order resulting in Table 4 and Table 5 . Thus, we get the Figure 20 where the steps of Kruskal's algorithm are applied (Erniyati, 2019).

Hence this is the shortest path to the store obtained after applying Kruskal's algorithm. The Figure 21 (Erniyati, 2019) shows difference in the values found by Kruskal's algorithm and google maps.

Erniyati, P citra (Erniyati, 2019) found that the Kruskal algorithm is 83% better than the Google direction API.

#### 5.4. Design of University LAN Networks

The problem is that there is a set of network nodes among given networking, and we need to find the possible shortest cable length required to connect all the nodes. The above problem is solved using the Prim's algorithm. The following is the problem statement:

Given a set of University buildings, connect them by a fibre network cables of direct terminal-to- terminal links having the smallest possible total length (total sum of cable lengths) (Gitonga, 2015). A set of buildings are connected if there is an unbroken chain of fibre links between every two buildings in the set (Gitonga, 2015). The aim here is to plan a large-scale Campus network based on fibre technology. Such networks are expensive to install but are very reliable. Today's world is highly dependent on modern data communication networks, especially in offices and campuses. Thus, installing optical fibre network offers a fast and reliable network that provides high-end internet services. Optical fibres use light for data transmission in the form of light pulses emitting from a light-emitting diode travelling through glass filaments and is received on the other end by a photosensitive device[5]. Since the installation of optical fibres is costly, it is essential to reduce excess wire usage because it leads to wastage of wires and money. The problem is solved by using connected undirected graph  $G = (V, E)$  where  $V$  is the set of University buildings, and  $E$  is the set of possible interconnections between pairs of buildings and for each edge  $(u, v) \in E$ , the weight  $(u, v)$  specifies the length of optic fibre cables needed. An acyclic subset  $T \subseteq E$  is attained connecting all the vertices and whose total weight is minimized. Since  $T$  is acyclic and will connect all the University buildings, it will form a tree that is a spanning tree (Chu et al, 2000). Thus, the spanning tree which will be of the least weight will be the minimum spanning tree. Prim's algorithm is a special case of the generic minimum spanning tree (Chu et al, 2000). that helps to obtain the shortest path.

As discussed in section 3.5, about the aerial map of Chuka University in Figure 13 and Figure 14 with the existing fibre network and after applying the Prim's algorithm, the amount of optical fibre used was reduced to a great extent (Gitonga, 2015).

### 5.5. Other Applications of Shortest Path Algorithms

A routing algorithm is a part of network layer software, which determines the outgoing route of the received packet. When studying Routing algorithms, there is a wide use of the shortest path algorithm. The main idea is to create a subnet figure. Each node in the diagram represents a router, and each arc is a communication line. In order to select the routing among a pair of routers, the algorithm should find the shortest path in the diagram. Dijkstra Routing algorithm is suitable for calculating the shortest path of a router to other routers. But in a computer network, if there are  $n$  routers, the Dijkstra Routing algorithm will be reused  $N$  times. Thus, the Floyd-Warshall routing algorithm is used more in practice, because it can calculate the shortest distance between any two routers.

Modern computer networks usually use Dynamic Routing algorithms, namely link state routing algorithm and distance vector routing algorithm. Link state routing protocol collects all kinds of information of the whole network, which constitute a topological database of routers. Open Shortest Path First (OSPF) is a typical protocol that is an internal gateway protocol used to make routing decisions within a single autonomous system. Besides, it is a specific implementation of Dijkstra's algorithm. It mainly uses the algorithm to generate a tree without loops. Then starting from a router and passing the information to all the routers in the tree. Each router is calculated in the local routing and avoids updating the routing table blindly. The distance vector routing algorithm is an algorithm where the router maintains a table. The table has the best path and route for each destination through exchanging the information with neighbouring routers to update the table information. RIP protocol is a dynamic routing protocol and uses the Bellman-Ford algorithm. The process of routing announcement is the process of the implementation of the Bellman-Ford algorithm. The routers collect all different paths to the destination and save the number of sites about information of each destination path. Any other information will be discarded, except the best route to the destination. The algorithm is distributed execution. All the routers are in the algorithm's execution, and the results are calculated together by all machines. In OSPF, the algorithm only executes on one machine, which is not distributed.

## 6. CONCLUSION

The shortest path problem is still one of the most explored topics in the research field. This paper discusses the basic principle of the five shortest path algorithms and compares them by analysing time complexity. It also summarizes few applications of the algorithms that have been discussed in Table 6. Dijkstra's algorithm is a classical single source algorithm, and the Bellman-Ford algorithm can be used when there is a negative loop. The Floyd-Warshall algorithm is a dynamic programming algorithm that can solve the shortest path problem between any two vertices. Kruskal's algorithm and Prim's algorithm are widely used algorithms since they help in getting a minimum spanning tree that connects each node. All algorithms cannot be applied directly; there are certain conditions under which they work. Kruskal's algorithm and Prim's algorithm cannot be used if the graph is directed since they fail under such condition. Prim's algorithm has better time complexity than Kruskal's algorithm; thus, Prim's algorithm works faster in dense graphs when compared to Kruskal's algorithm. Depending upon the conditions, we must apply a suitable algorithm. However, in practical applications, the algorithms are always optimised to increase efficiency, like the heap optimisation and SPFA.

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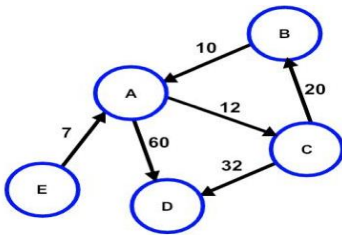
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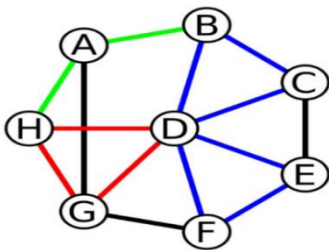


## FIGURES

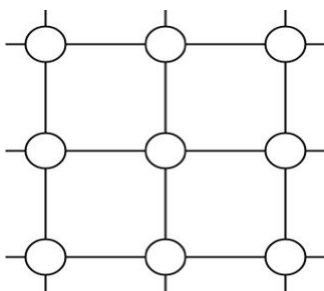
**FIGURE 1: A DIRECTED GRAPH**



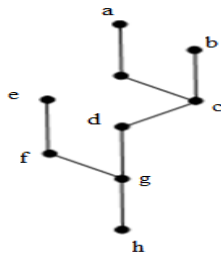
**FIGURE 2 A DIRECTED GRAPH**



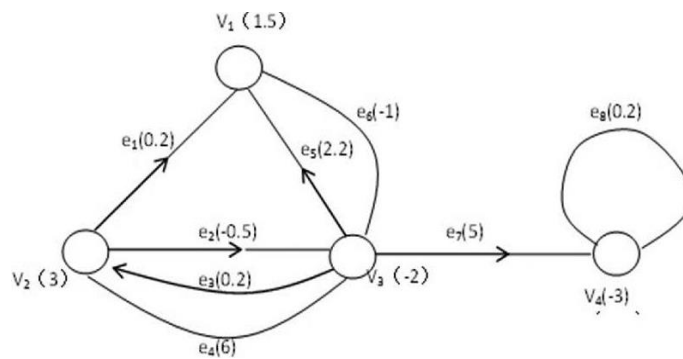
**FIGURE 3 AN INFINITE GRAPH**



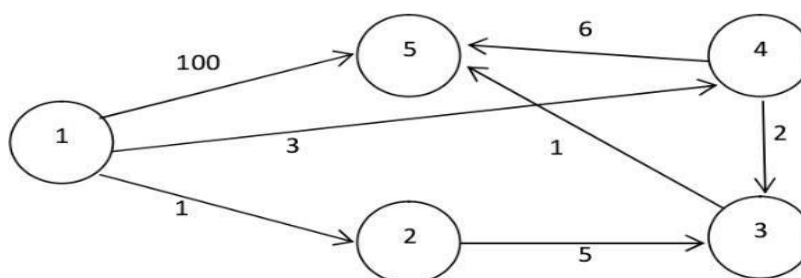
**FIGURE 4 A PSEUDOGRAPH**



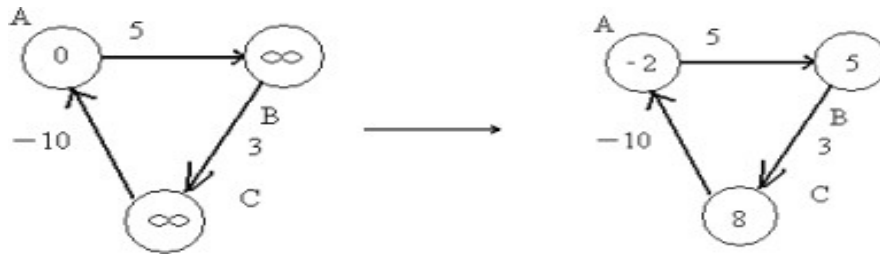
**FIGURE 5: WEIGHTED GRAPH**



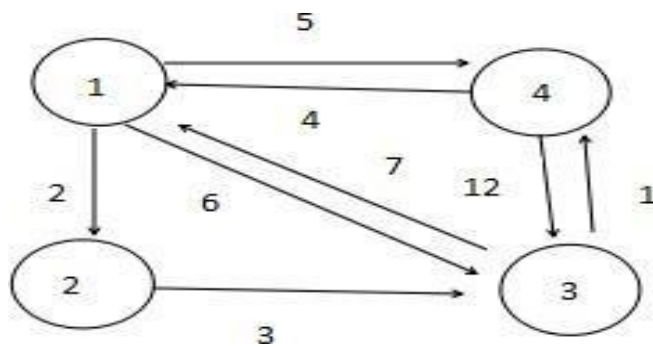
**FIGURE 6 STEPS OF THE ALGORITHM**



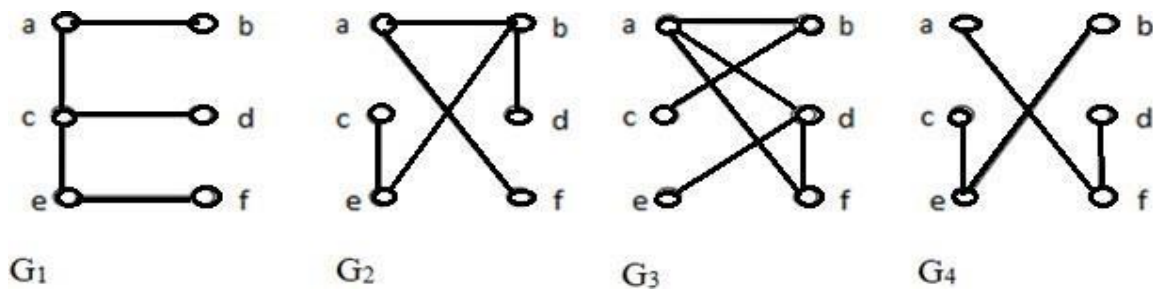
**FIGURE 7: NEGATIVE LOOP**



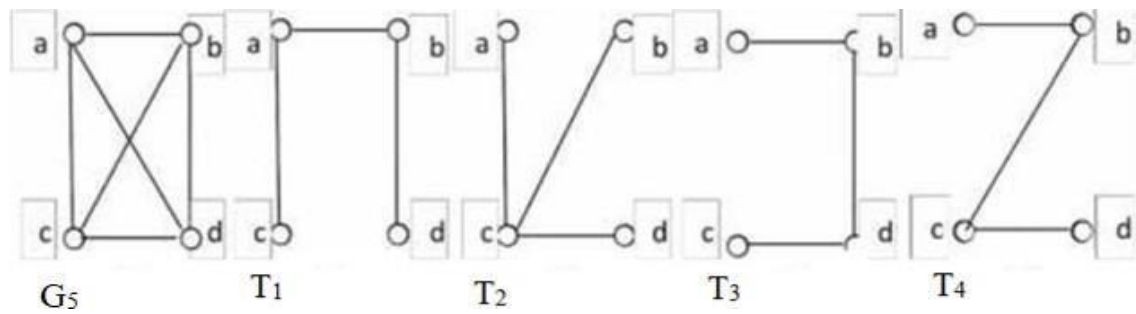
**FIGURE 8. FLOYD-WARSHALL ALGORITHM**



**FIGURE 9 ILLUSTRATES SEVERAL EXAMPLES TO DISTINGUISH GRAPHS WHICH ARE TREES AND WHICH ARE NOT.**



**FIGURE 10 EXPLAINS THAT  $G_5$  IS A GRAPH AND  $T_1, T_2, T_3, T_4$ , ARE THE CORRESPONDING SPANNING TREES.**



**FIGURE 11 AN EXAMPLE OF KRUSKAL'S ALGORITHM WHERE ERNIYATI, P CITRA FOUND SHORTEST PATH TO A BUILDING**

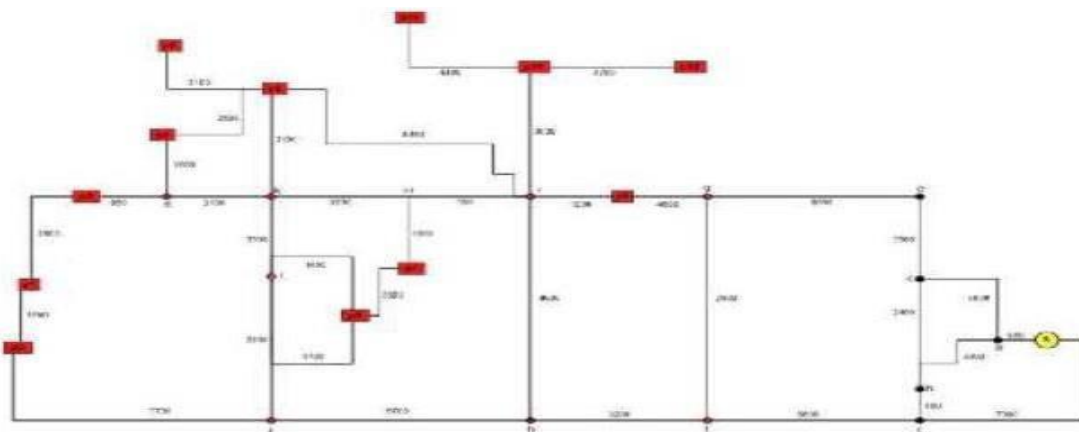
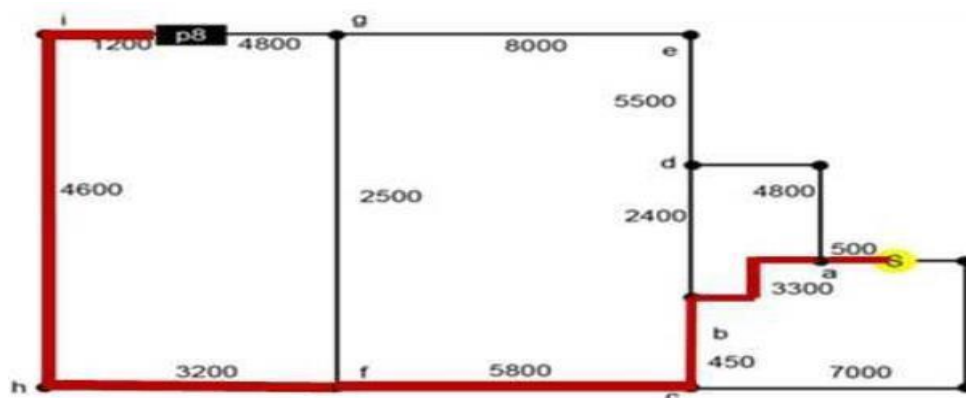


Figure 11

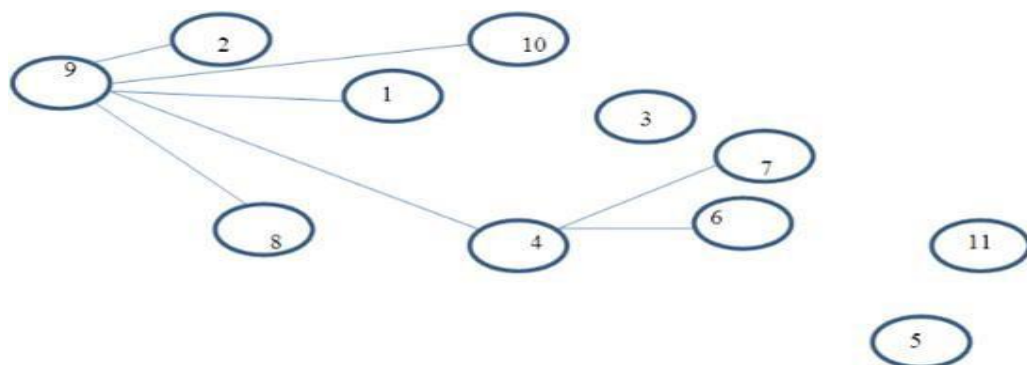
**FIGURE 12 THE SHORTEST PATH AFTER APPLYING THE STEPS OF KRUSKAL'S ALGORITHM**



**FIGURE 13 THE AERIAL MAP OF THE CHUKA UNIVERSITY**



**FIGURE 14 THE EXISTING NETWORK OF CHUKA UNIVERSITY.**



**FIGURE 15 THE NEW FIBRE NETWORK CONNECTING THE BUILDINGS WHERE IT IS EVIDENT THAT THE AMOUNT OF CABLE USED NOW HAS SIGNIFICANTLY REDUCED.**

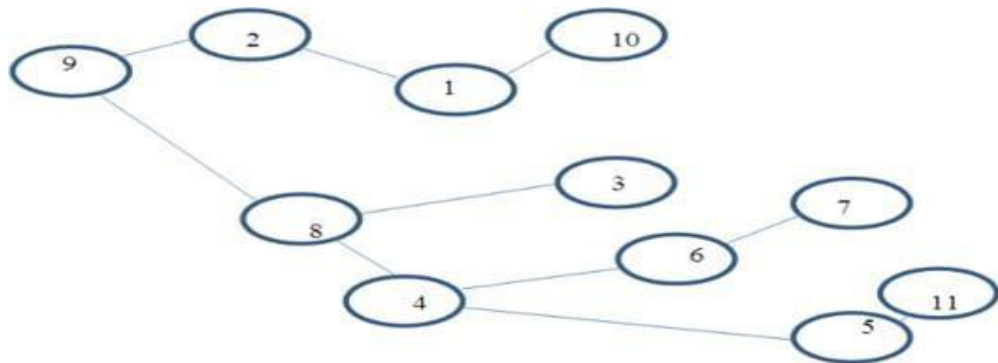
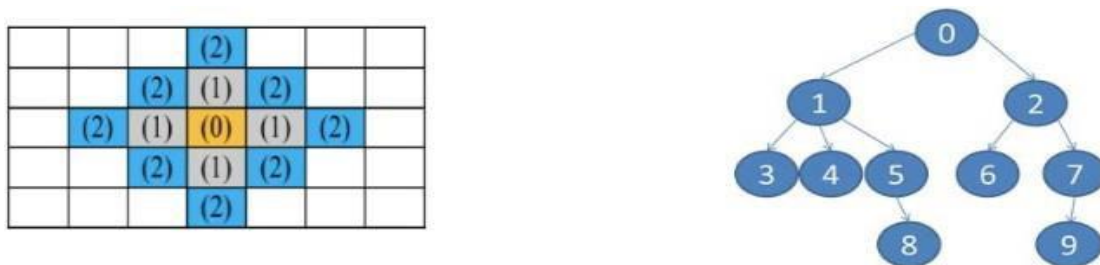
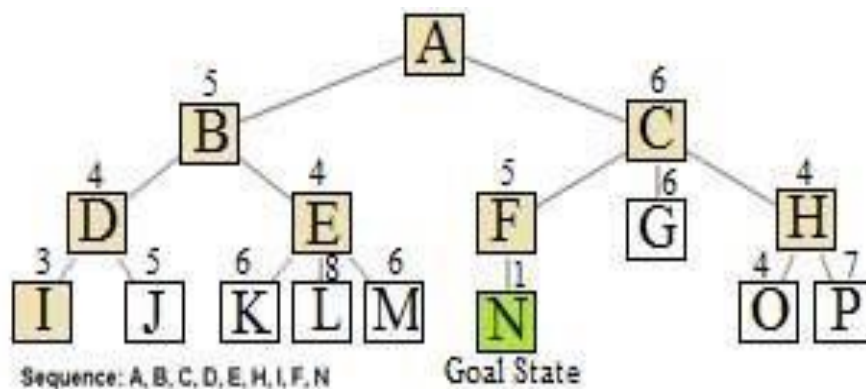


Figure 15

**FIGURE 16 COST STORAGE TO DETERMINE THE ORDER OF CELLS VISITED**

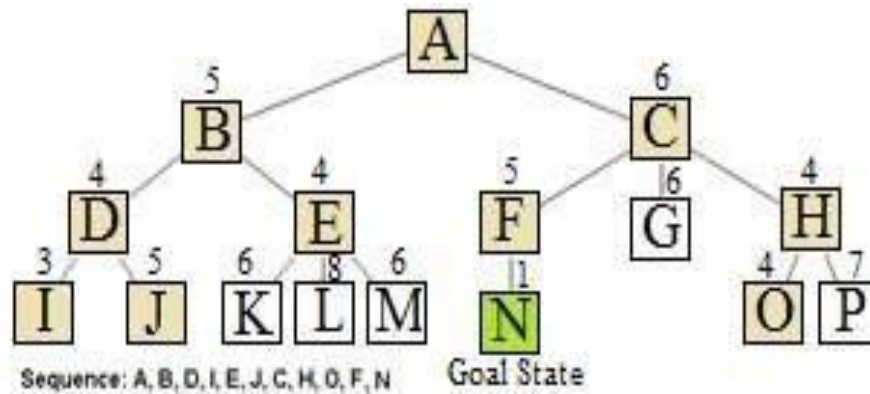


**FIGURE 17: A\* ALGORITHM SEQUENCE**





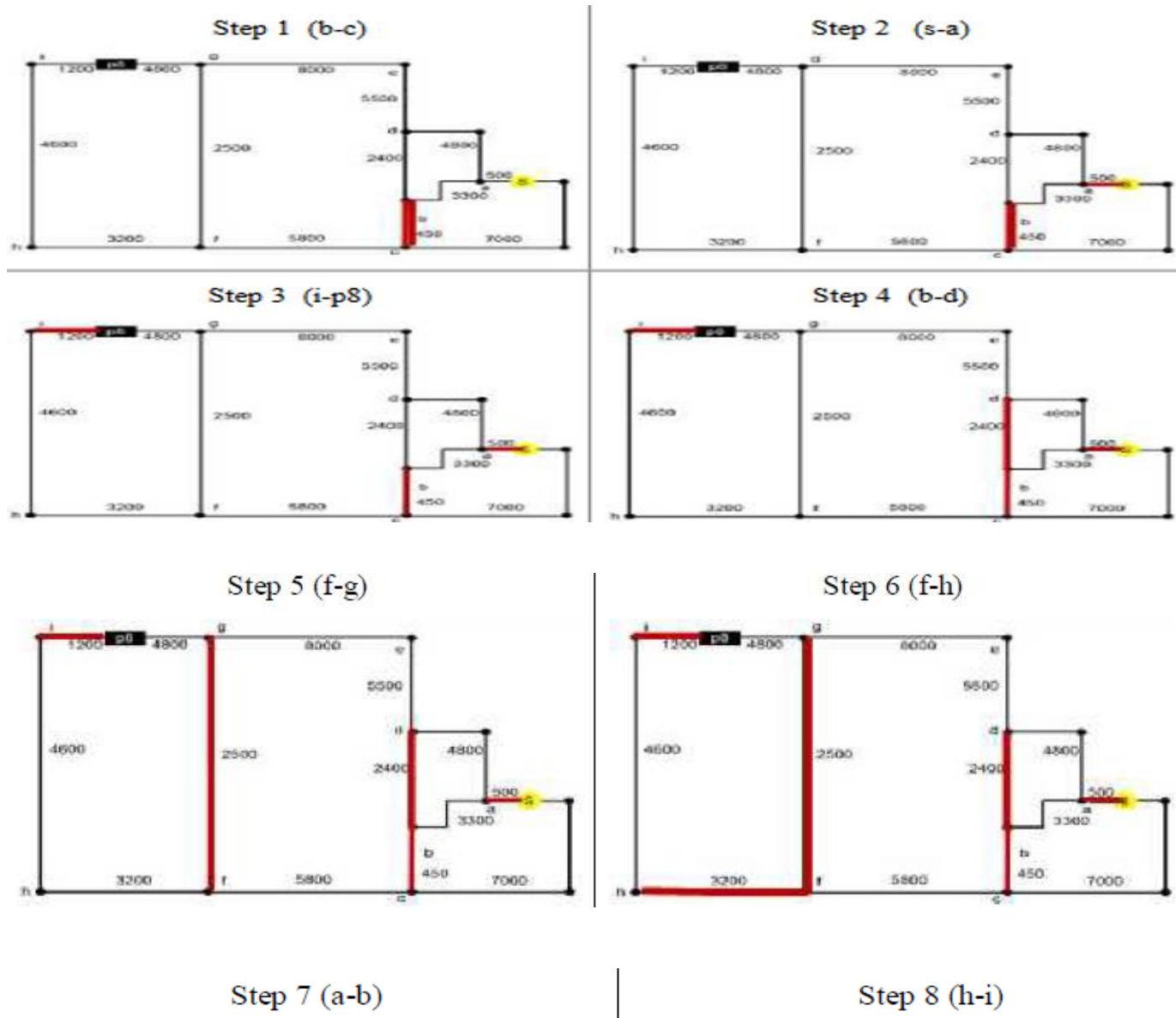
**FIGURE 18: BEST FIRST SEARCH ALGORITHM SEQUENCE**



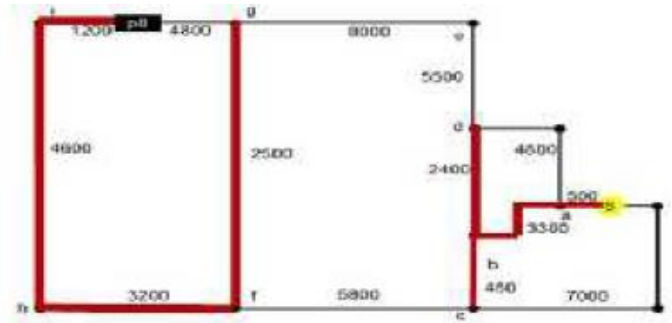
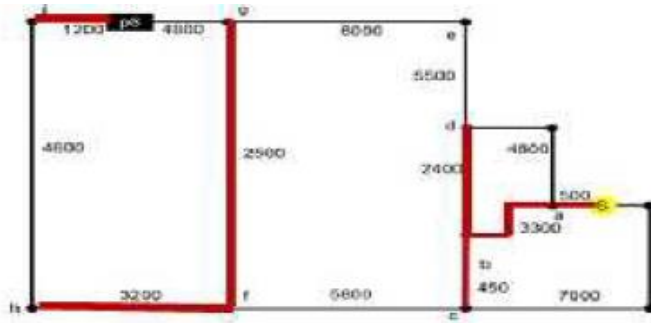
**FIGURE 19: STARTING POINT IN KRANGGAN NO.100 KERANGGAN ROAD, GUNUNG PUTRI, BOGOR TO 12 STORE LOCATIONS WITH SEVERAL NODES**

p1 (toko Subur Jaya, Jl. Raya Tajur No. 315 Kec. Bogor Timur, Kota Bogor)	p7 (TB. Pandu Makmur , Jl. Tegal Gundil Kec. Bogor Utara )
p2 (TB. Hutan Mas, Jl. Raya Tajur Ciawi Kec. Bo gor Timur)	p8 (TB. Jawa Jl. Raya Bogor Kedung Halang Km. 55 No. 225 Kec Bogor Utara)
p3 (TB. Kurnia Jl. Raya Tajur No. 63A Pakuan, Kec. Bogor Selatan)	p9 (TB. Abadi Jaya Toko, Jl. Sindang Barang No. 61 Gunung Batu, Kec. Bogor Barat)
p4 (TB. Setia Makmur, Jl. Pahlawan No. 183 Bondongan, Kec, Bogor Selatan),	p10 (TB. Sarana Bangunan, Jl. Raya Semplak No. 196 Atang Senjaya Kemang, Kec. Bogor Barat)
p5 (TB. Prapatan Tegal Lega, Jl. Tegal Lega No. 1, Kec. Bogor Tengah)	p11 (TB. Wahana Agung , Jl. Raya Cibadak - Ciampea Cibadak Tanah Sareal Kota Bogor)
p6 (TB. Setia Abadi, Jl. Pengadilan No. 1 DD Kec. Bogor Tengah)	p12(TB. Purba , Jl. Kayu Manis No. 85 Cibadak Kec. Tanah Sareal Kota Bogor)

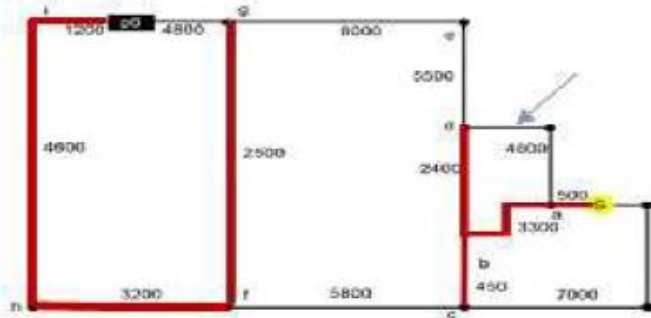
**FIGURE 20 THE STEPS OF KRUSKAL'S ALGORITHM ARE APPLIED.**





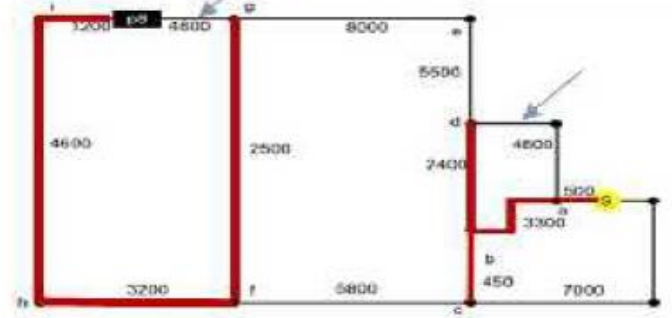


Step 9 (a-d)



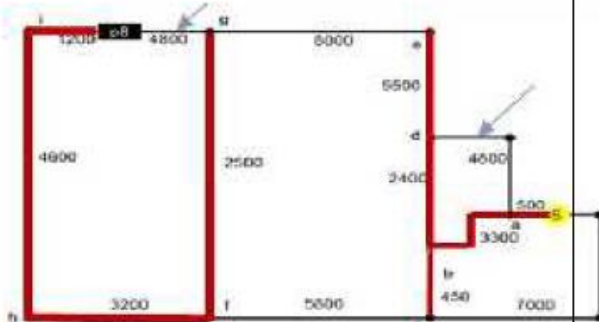
a-d will form a cycle, so it is only depicted with arrows

Step 10 (g-p8)

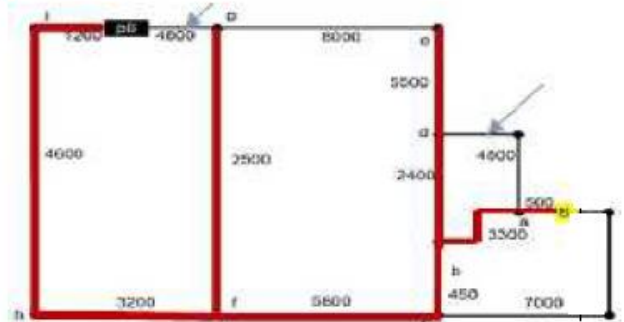


g-p8 will form a cycle, so it is only depicted with arrows

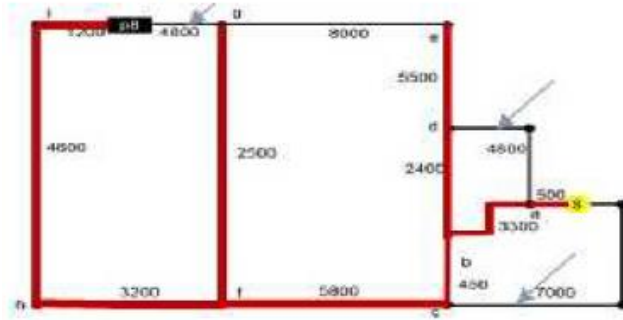
Step 11 (d-e)



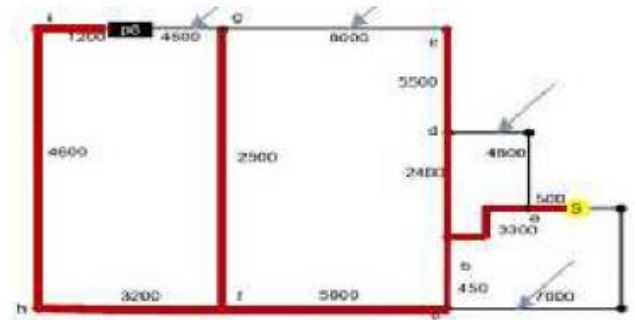
Step 12 (c-f)



Step 13 (a-c)



Step 14 (e-g)



e-g will form a cycle, so it is only depicted with arrow

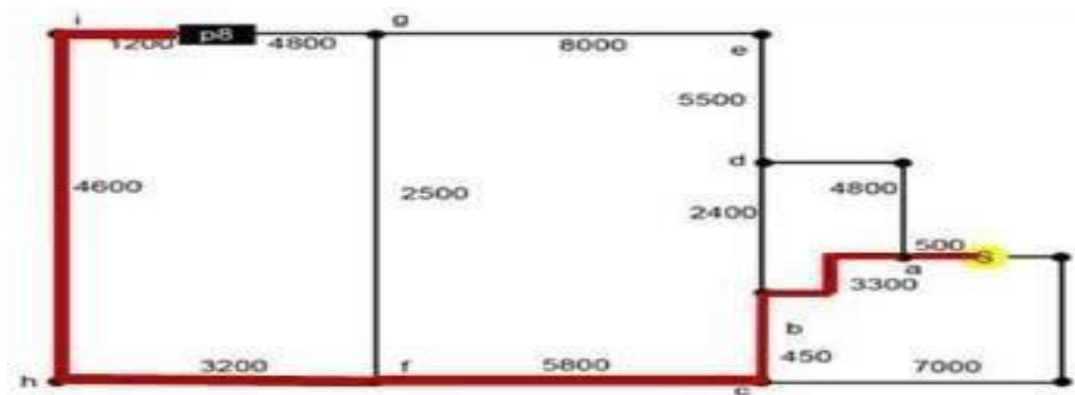
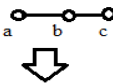
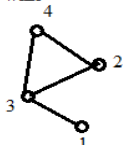
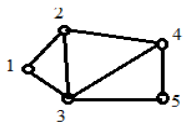
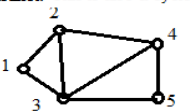


Figure 20

**THE FIGURE 21 SHOWS DIFFERENCE IN THE VALUES FOUND BY KRUSKAL'S ALGORITHM AND GOOGLE MAPS.**

Ket.	Starting point	Location Destination	Algoritma Kruskal (km)	Direction API (km)	Differences
p1	-6.453397, 106.884287	-6.644528, 106.839962	30.3	29	-1.3
p2	-6.453397, 106.884287	-6.653122, 106.845728	31.5	31	-0.5
p3	-6.453397, 106.884287	-6.627004, 106.822351	27.5	29.1	1.6
p4	-6.453397, 106.884287	-6.617562, 106.805694	28.5	30.5	2
p5	-6.453397, 106.884287	-6.591769, 106.814624	22.95	24.7	1.75
p6	-6.453397, 106.884287	-6.591890, 106.793374	22.7	26.4	3.7
p7	-6.453397, 106.884287	-6.571830, 106.816978	19.3	21.9	2.6
p8	-6.453397, 106.884287	-6.555761, 106.816577	19.0	20	1
p9	-6.453397, 106.884287	-6.588110, 106.774094	27.8	28.2	0.4
p10	-6.453397, 106.884287	-6.549278, 106.760727	28.6	31	2.4
p11	-6.453397, 106.884287	-6.556291, 106.778665	24.2	27.3	3.1
p12	-6.453397, 106.884287	-6.536932, 106.773841	25.3	28	2.7
Means					1.6

**TABLE 1 EXPLAINS DEFINITIONS OF A WALK, PATH, TRAIL, CIRCUIT AND CYCLE WITH EXAMPLES.**

<p>1.Walk</p>  <p>Edge set = {ab,bc} vertex set={a,b,c} walk= a,ab,b,bc,c An example of walk which is path</p>	<p>2.Closed walk</p> <p>132431 walk=&gt; 1,13,3,32,2,24,4,43,3,31 Starts with vertex 1 and ends with 1 only. Diagram of above walk</p> 	<p>3.Trail</p> <p>123453 walk=&gt;1,12,2,23,3,34,4,45,5,53,3 In the above set, each edge is distinct but not a path since 3 is repeated. Diagram of above walk</p> 	<p>4.Circuit</p> <p>1234531 walk=&gt;1,12,2,23,3,34,4,45,5,53,3,31,1 1.Closed walk 2.Vertices may/may not repeat 3.Edges should be distinct. This is also a cycle.</p> 
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**TABLE 2 STEPS OF THE ALGORITHM**

Circulation	V	Node2	Node3	Node4	Node5
Initial node	1	1	Max	3	10
1	1,2	1	6	3	10
2	1,2,4	1	5	3	9
3	1,2,4,3	1	5	3	6
4	1,2,4,3,5	1	5	3	6

**TABLE 3: AN EXAMPLE OF THE FLOYD-WARSHALL ALGORITHM**

0	2	6	4
$\infty$	0	3	$\infty$
7	$\infty$	0	1
5	$\infty$	12	0

**TABLE 4 GRAPH DATA WITH DISTANCE BETWEEN VERTICES**

No.	Starting vertex	Ending vertex	distance	No.	Starting vertex	Ending vertex	distance
1	s	a	500	8	d	e	5500
2	s	c	7000	9	e	g	8000
3	a	b	3300	10	f	g	2500
4	a	d	4800	11	f	h	3200
5	b	c	450	12	g	P8	4800
6	b	d	2400	13	h	i	4600
7	c	f	5800	14	i	P8	1200

**TABLE 5 GRAPH DATA WITH DISTANCE BETWEEN VERTICES  
 ARRANGED IN ASCENDING ORDER**

No.	Starting vertex	Ending vertex	distance	No.	Starting vertex	Ending vertex	distance
1	b	c	450	8	h	i	4600
2	s	a	500	9	a	d	4800
3	i	P8	1200	10	g	P8	4800
4	b	d	2400	11	d	e	5500
5	f	g	2500	12	c	f	5800
6	f	h	3200	13	s	c	7000
7	a	b	3300	14	e	g	8000

**TABLE 6 SHOWS THE RELATIVE DISTANCE TO ICT IN METERS.**

Building	Relative distance to ICT centre in Meters
ICT Centre	0
Library	30
Finance	80
Media studio	1200
Science tuition block	25
Student centre	45
Business school centre	180
University pavilion	150
Health centre	300
Female hostels	200

**TABLE 7 PRESENTS THE APPLICATIONS OF THE SHORTEST PATH ALGORITHM**

	ALGORITHM	APPLICATIONS
1	Dijkstra's Algorithm	<ul style="list-style-type: none"> <li>• Google maps</li> <li>• IP routing to find Open Shortest Path First</li> <li>• Telephone network</li> <li>• Flight Radius Problem</li> <li>• Waste management problem</li> </ul>
2	Kruskal's Algorithm	<ul style="list-style-type: none"> <li>• Finding Minimum Spanning Tree</li> <li>• Landing cable</li> <li>• Tv network</li> <li>• Tour operations</li> </ul>
3	Prim's Algorithm	<ul style="list-style-type: none"> <li>• Finding Minimum Spanning Tree</li> <li>• The relationship between combat units on a battlefield</li> </ul>
4	Floyd-Warshall Algorithm	<ul style="list-style-type: none"> <li>• Finding shortest path in directed graphs</li> <li>• To Check a given undirected graph is Bipartite</li> <li>• Finding Maximum band-width path in flow networks</li> </ul>
5	Viterbi's Algorithm	<ul style="list-style-type: none"> <li>• Solving diverse shortest paths for bioimage analysis</li> </ul>
6	Lee's Algorithm	<ul style="list-style-type: none"> <li>• Maze problem</li> </ul>
7	Link State Routing Algorithm	<ul style="list-style-type: none"> <li>• Internet protocol networks using shortest open path first</li> </ul>

## संस्कृत साहित्य में मानववाद

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### शोधपत्र-सारांश

मानववाद चिन्तन की एक महत्त्वपूर्ण प्रणाली है, जिसमें मानव की प्रतिष्ठा सर्वश्रेष्ठ सत्ता के रूप में की गयी है। मानववाद यदि मानव को सर्वोच्च सत्ता के रूप में स्थापित करने वाला दर्शन है, तो यह कार्य सर्वाधिक पूर्णता के साथ संस्कृत साहित्य में किया गया है। अद्वैतवाद ब्रह्मवेत्ता मानव को ब्रह्म मानता है तथा यह मानव की श्रेष्ठतम अवस्था है। यह बात सामान्यतया प्रचलित मानववाद में अप्रचलित एवं अटपटी लगती है, किन्तु इस प्रश्न पर विचार करने पर कि मानव क्या है? ये अटपटापन समाप्त होने लगता है। मानव शरीर है या आत्मा, मानव सत्ता भौतिक है या आध्यात्मिक सत्ता? इन प्रश्नों पर सम्यक विचार कर पण्डित दीनदयाल उपाध्याय ने एकात्ममानवदर्शन प्रतिपादित किया।

एकात्ममानववाद भारत की प्राचीन दार्शनिक परम्परा के वैचारिक अधिष्ठान से प्रस्फुटित एक क्रान्तिकारी विचारधारा है जिसके बीज भारतीय परम्परा में वेदों, उपनिषदों एवं भगवद्गीता में देखे जा सकते हैं। इस शोध-पत्र का उद्देश्य संस्कृत साहित्य में व्याप्त इन्हीं मानववाद सम्बन्धी विचारों का संकलन करते हुए उपाध्याय जी के एकात्ममानव दर्शन की मुख्य प्रवृत्तियों का विश्लेषण करना है।



### संस्कृत साहित्य में मानववाद

क्या बाजारवाद (पूँजीवाद) तथा राज्यवाद (साम्यवाद) विचारधाराएँ आधुनिक मानव को आन्तरिक सुख दिला सकती हैं ? क्या भारतवासी पश्चिमी अवधारणाओं के अनुसार ही जीवन जीने को अभिशप्त हैं ? क्या भारतीय मनीषा के पास इसका कोई समाधान नहीं है ? एकात्ममानववाद के रूप में पण्डित दीनदयाल उपाध्याय ने इन प्रश्नों का दार्शनिक समाधान किया है ।

एकात्म मानववाद कोई नवीन विचारधारा नहीं है, वरन इसकी पृष्ठभूमि के दो आयाम हैं: भारतीय संस्कृति तथा पाश्चात्य जीवनदर्शन । मानववाद मुख्यतः पाश्चात्य अवधारणा है तथा एकात्मता भारतीय । अतः कहा जा सकता है कि एकात्म मानववाद भारत की प्राचीन दार्शनिक परम्परा के वैचारिक अधिष्ठान से प्रस्फुटित एक क्रान्तिकारी विचारधारा है जिसके बीज भारतीय परम्परा में वेदों, उपनिषदों एवं भगवद्गीता में देखे जा सकते हैं । वस्तुतः एकात्ममानववाद की प्रवृत्तियाँ मूलतः एकात्मता, समग्रता, पूरकता तथा आत्मीयता के भावों में निहित हैं, जिनकी तलाश प्राचीन संस्कृत साहित्य में की जा सकती है ।

#### क) एकात्मता

एकात्ममानववाद का केंद्रीय विचार है कि जीवन समग्र है । यह जीवन को खण्ड-खण्ड में बाँटकर पुनः उन खण्डों को एक में जोड़ने की पद्धति नहीं है । समस्त विभिन्नताओं और विविधताओं के पीछे एक एकात्मता है । एकात्मता भारतीय दर्शन की आधारभूत मान्यता है । इसके अनुसार “यत् पिण्डे तत् ब्रह्माण्डे” (जो पिण्ड में है वही ब्रह्माण्ड में है) । अंश और सम्पूर्ण, तत्त्वतः एक हैं । अर्थात् समस्त विश्व-ब्रह्माण्ड में एक ही चेतना व्याप्त है । व्यक्ति चेतना से ब्रह्माण्ड चेतना तक उसका एक ही स्वरूप है । एक ही परम सत्य की अभिव्यक्ति है संपूर्ण विश्व-



ब्रह्माण्ड जिसके अंदर एक आंतरिक एकात्मता है। एकात्मता की इस अवधारणा का बीज ऋग्वेद के पुरुष सूक्त और नासदीय सूक्त में दिखायी पड़ता है। पुरुष सूक्त के अनुसार, “पृथ्वी, स्वर्ग, ग्रह, नक्षत्र, चेतन, अचेतन सभी पदार्थ एक ऐसे पुरुष के अंश हैं जो सम्पूर्ण विश्व में व्याप्त भी है और उसके बाहर भी; अर्थात् विश्वव्यापी एवं विश्वातीत दोनों है। जो कुछ है और जो कुछ होगा सभी एक ही तत्त्व में अन्तर्भूत है।<sup>1</sup> ऋग्वेद के नासदीय सूक्त में एकवादी विचारधारा का मूल दिखायी पड़ता है। इस सूक्त में सम्पूर्ण ब्रह्माण्ड की उत्पत्ति एक मूल कारण से बतायी गई “उस समय न सत् था और न असत्, पृथ्वी भी नहीं थी, आकाश भी नहीं था तथा न उससे ऊपर व्योम। आवरण भी कहाँ था?.... उस समय मृत्यु भी नहीं थी, अमरता भी नहीं थी। रात और दिन का भेद नहीं था। वायु, शून्य और श्वास-प्रश्वासयुक्त केवल ब्रह्म ही था। उसके अतिरिक्त और कुछ भी नहीं था”।<sup>2</sup>

वेद वाङ्मय के ही सारभूत विचार, जिसे वेदांत कहते हैं, ऐसे उपनिषदों ने सम्पूर्ण सृष्टि की एकात्मकता का प्रतिपादन किया है। “सर्वं खल्विदं ब्रह्म, नेह नानास्ति काञ्चन”<sup>3</sup> अर्थात् सृष्टि के रूप में प्रतीत होने वाला संपूर्ण दृश्य केवल ब्रह्म का ही आविष्कार है। इसमें प्रतीत होने वाली विविधता एक ही शक्ति का विलास है। इस सिद्धान्त को पंडितजी ने सीधे अपने शब्दों में अनूदित किया है। विस्तृत होने पर भी पश्चिमी दर्शन और एकात्म मानव दर्शन की मौलिक भिन्नता जानने के लिए यह परिच्छेद पठनीय है -

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<sup>1</sup> सहस्रशीर्षा पुरुषः सहस्राक्षः सहस्रपात.....

स भूमिं विश्वतो वृत्वात्यतिष्ठदशाङ्गुलम् ॥ ऋग्वेद पुरुषसूक्त-10.90

<sup>2</sup> नासदासीन्नो सदासीत्तदानीं नासीद्रजो नो व्योमा परोयत् ।

किमावरीवः कुह कस्य शर्मन्नम्भः किमासीद गहनं गभीरम् ॥

न मृत्युरासीदमृतं न तर्हि न रात्र्या अहन् आसीत्प्रकेतः ।

आनीदवातं स्वधया तदेकं तस्माद्धान्यन्न परः किं चनास ॥ ऋग्वेद, नासदीयसूक्त-10.129

<sup>3</sup> बृ. 4.41.19

“इस प्रकार हमारी प्रकृति ब्रह्मनिष्ठ है, जिनको हम देख नहीं पाते, ऐसे सबको-सम्पूर्ण सृष्टि को-केन्द्र मानकर चलते हैं। हम इस केन्द्र की ओर चलते हैं, वे बाहर की ओर चलते हैं। केन्द्र की ओर चलने से हम केन्द्र के निकट आते हैं। वहाँ जितने व्यक्ति उतने ही केन्द्र हैं, वे केन्द्र से बाहर चलते हैं। अतः केन्द्र से दूर चले जाते हैं। हमारे यहाँ केन्द्र ईश्वर, आत्मा, ब्रह्म कुछ भी कहें- है। इसलिए हम सब में एक आत्मा मानते हैं। पश्चिम वाले सब को यन्त्रवत् मानते हैं, समाज भी उनके लिए एक यंत्र है। हम समाज, राज्य, राष्ट्र सब में ईश्वर या चैतन्य मानते हैं। इस सम्पूर्ण विश्व में एक चैतन्य की कल्पना करते हैं-ईश्वर सब में मौजूद है। हम आत्मवादी हैं, वे अनात्मवादी हैं, जड़वादी हैं। हम समाज राष्ट्र को भी आत्म-ईश्वर का रूप मानकर चलते हैं, वे केवल यन्त्रवत् राष्ट्र की कल्पना लेकर चलते हैं।”<sup>4</sup>

ईशावस्य उपनिषद् के आरम्भ में ही “ईशावास्पमिदं सर्वं यत्किञ्च जगत्यां जगत्”<sup>5</sup>, तथा अन्य उपनिषदों में- “आत्मैवेदं सर्वम्”<sup>6</sup> में तथा “सर्वं खल्विदं ब्रह्म”<sup>7</sup> - भी यही बात कही गयी है। अर्थात् इस अखिल सृष्टि में ब्रह्म से लेकर चींटी तक जो कुछ भी है ईश्वरमय अथवा ब्रह्ममय ही है। ईशोपनिषद में आगे भी यह पुनः स्पष्ट किया गया है कि सम्पूर्ण अस्तित्व एक ही चैतन्यशक्ति का विलास है। दो तत्त्वों का अस्तित्व ही नहीं है। सब कुछ मुझमें है और सब मैं ही हूँ, यही पूर्ण ज्ञान है -

यस्तु सर्वाणि भूतानि आत्मन्येवानुपश्यति,

<sup>4</sup> दीनदयाल उपाध्याय, संपूर्ण बाङ्मय, खण्ड11, पृ.16

<sup>5</sup> ईशावस्योपनिषद मंत्र,1

<sup>6</sup> छान्दोग्योपनिषद 7.25.2

<sup>7</sup> वही. 6.114.1

सर्वभूतेषु चात्मानं ततो न विजुगुप्सते ॥<sup>8</sup>

उपनिषदों का यह अद्वैत ही एकात्म मानव दर्शन का मूल आधार है। और उपनिषदों का यह अद्वैत सिद्धान्त अद्यतन पदार्थ विज्ञान भी मान्य कर रहा है। जगद्दिख्यात् नोबल पुरस्कार विजेता डॉ. फ्रिजाफ काप्रा अपने सुविख्यात ग्रन्थ The Tao of Physics में कहते हैं-

“The most important characteristic of the eastern world view is the basic oneness. All things are seen as interdependent and inseparable parts of the “cosmic whole”, as different manifestations of the ultimate reality. As we study the various models of subatomic physics, we shall see that they express again and again, in different ways, the same insight that the constituents of matter and the basic phenomena involving them are interconnected, interrelated and interdependent; they cannot be understood as isolated entities but only as integrated part of the whole.”<sup>9</sup>

[ पूरब की दुनिया के दृष्टिकोण की सबसे महत्वपूर्ण विशिष्टता इसकी एकात्मता है। सभी चीजें एक-दूसरे पर निर्भर और “सम्पूर्ण” ब्रह्माण्ड के अविभाज्य अंश के रूप में देखी जाती हैं, एक ही परमसत्य के बहुविध प्रकटीकरण के रूप में। यदि हम सूक्ष्माणु भौतिकी के विभिन्न प्रारूपों का अध्ययन करें तो हम बार-बार और अलग-अलग ढंग से उसी अंतर्दृष्टि को प्रकट होते देख सकते हैं कि द्रव्य के घटक और उनकी भागीदारी वाली मूलभूत घटना सभी परस्पर संबद्ध, परस्पर सम्बन्धित और एक-दूसरे पर निर्भर हैं। उन्हें अलग-अलग घटकों के रूप में नहीं, बल्कि सम्पूर्ण और उसके अविभाज्य अंश के रूप में ही समझा जा सकता है।]

ख) समग्रता

प्रकृति का अर्थ ही है “सन्तुलित समग्रता”। तात्कालिक कारणों से किसी एक आयाम का आग्रह करना तथा अन्य आयामों की उपेक्षा करना, दूरगामी दृष्टि से असन्तुलन उत्पन्न

<sup>8</sup> ईशावास्योपनिषद्, मन्त्र 6

<sup>9</sup> Tao of Physics, 10 The Unity of All Things

करता है यथा, अपनी तात्कालिक (कागज, आवास, फर्नीचर व ईंधन) आवश्यकताओं की पूर्ति के लिए मनुष्य जंगल काटता है। इससे पर्यावरण में असन्तुलन आता है तथा सूखा, अतिवृष्टि, भूमंडलीय तापन की समस्या उत्पन्न होती है। सुख का एकांगी व उपभोगवादी चिंतन समाज एवं व्यक्ति को शोषण की प्रेरणा देता है। शोषण की प्रवृत्ति समाज और प्रकृति, दोनों का उत्पीड़न करती है, पर्यावरण को बिगाड़ती है तथा भावी पीढ़ियों के लिए कठिनाइयाँ उत्पन्न करती है। उपाध्याय जी कहते हैं “प्रकृति की सम्पदा अपार होते हुए भी उसकी मर्यादा है। अतः प्रकृति से उतना तथा इस प्रकार लें कि वह उस कमी को स्वयं पूरित कर ले”।<sup>10</sup> पश्चिम का उद्योगवाद, एकांगी होने के कारण ही यांत्रिक व अमानवीय होकर प्रकृति के लिए संहारक बन गया है। समग्रतावादी अर्थव्यवस्था प्रकृति के शोषण पर नहीं, पोषण पर अवलम्बित है। “प्रकृति का स्तन्य हमारे लिए जीवनदायी हो, ऐसी व्यवस्था करनी चाहिए”।<sup>11</sup>

भारतीय सन्दर्भ में यह दृष्टिकोण वैदिक काल से ही दृष्टिगोचर होता है। अथर्ववेद के रुद्राष्टाध्यायी के ऋषि भगवान शिव से प्रार्थना करते हुए कहता है कि हमारी नदियाँ जल से परिपूर्ण हों, हमारी औषधियाँ मधुमती बनें, वन पेड़-पौधों से भरे हों तथा हमारी गायें मीठे दूध से युक्त हों। इस प्रार्थना में ऋषि सम्पूर्ण जड़-चेतन सृष्टि की स्वस्थता की कामना करता है, क्योंकि सम्पूर्ण सृष्टि की स्वस्थता में ही मानव की स्वस्थता भी सन्निहित है। भारतीय मनीषी भर्तृहरि का कथन -“न जातु कामाः कामानामुपभोगेन शान्तयो”- इस बात पर बल देता है कि हमें प्रकृति से आग्रहशील होना चाहिए और प्रकृति से उतना ही

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<sup>10</sup> दीनदयाल उपाध्याय: कर्तृत्व एवं विचार, पृ. 428

<sup>11</sup> वही

लेना चाहिए जितना हम उसे वापस कर सकें । अस्तु, संस्कृत साहित्य ही एकात्ममानववाद की समग्रता, संपोष्यता, संतुलन एवं संयमन की दृष्टि का आधार है ।

#### ग) पूरकता

सृष्टि के अस्तित्व का कारण संघर्ष नहीं, वरन् “परस्परावलम्बन” व “पूरकता” है । वनस्पति और प्राणी, एक दूसरे की आवश्यकता को पूरा करते हुए ही जीवित रहते हैं । हमें आक्सीजन वनस्पतियों से मिलती है तथा वनस्पतियों को कार्बन डाइआक्साइड प्राणि जगत से प्राप्त होती है । उपाध्याय जी ने इसे स्पष्ट करते हुए कहा है-

“संसार में एकता का दर्शन कर, उसके विविध रूपों के बीच परस्पर पूरकता को पहचान कर, उसमें परस्पराणुकूलता का विकास करना तथा उनका संस्कार करना संस्कृति है”। प्रकृति को ध्येय की सिद्धि के अनुकूल बनाना संस्कृति तथा प्रतिकूल बनाना विकृति है । संस्कृति, प्रकृति की अवहेलना नहीं, उसकी ओर दुर्लक्ष नहीं करती, बल्कि प्रकृति में जो भाव सृष्टि की धारणा करने वाले तथा उसको अधिक सुखमय एवं हितकर बनाने वाले हैं, उनको बढ़ावा देकर दूसरी प्रवृत्ति की बाधा को रोकना, यही संस्कृति है” ।

“माता भूमिः पुत्रोऽहंपृथिव्याः” अर्थात् ‘यह भूमि माता है और मानव इस पृथ्वी का पुत्र है, इस भावना के साथ प्रकृति के साथ याचनापूर्वक कुछ प्राप्त करना तथा प्रत्युपकार के द्वारा प्रकृति को कुछ प्रदान करते रहना, यह प्राचीन भारतीय मान्यता थी । पुनश्च, ऋषि अश्वत्थ वृक्ष का आश्रय लेते हुये मुण्डकोपनिषद् में कहता है

द्वा सुपर्णा सयुजा सखाया समानं वृक्षं परिषस्वजाते ।



तयोरन्यः पिप्पलं स्वादति अनश्रन्न्यो अभिचाकशी ॥<sup>12</sup>

“अभिज्ञानशाकुन्तलम्”<sup>13</sup> में शकुन्तला वृक्षों को जल पिलाए बिना स्वयं जल नहीं ग्रहण करती, आभूषण पसन्द करते हुए भी स्नेहवश अपने अलंकरण के लिए पेड़ों के फूल नहीं तोड़ती, मृगी के नवजात शिशु की सेवा वह इसलिए करती है, क्योंकि मृगी प्रसव-काल में ही समाप्त हो गयी थी और शिशु अनाथ था। ऐसा लगता ही नहीं कि फूल-पत्तियाँ, मृग तथा शकुन्तला में कोई कोटिगत भेद है। सब कुछ एक सामञ्जस्य में आबद्ध दिखायी पड़ता है। इसका परिणाम यह है कि शकुन्तला के विदाई के समय वृक्ष उसे वल्कल आदि उपहार देते हैं, पीले पत्ते गिराकर आँसू बहाते हुए शोक व्यक्त करते हैं,<sup>14</sup> तथा मृगशावक उसका वस्त्र पकड़कर जाने से रोकता है। यह परस्परपूरकता का अद्भुत चित्रण है। इस युग तक वह पूरकता एवं समग्रता की दृष्टि विद्यमान थी जिसे विकसित करने के लिए वर्तमान काल में उपाध्याय जी प्रयत्नशील दिखते हैं।

#### घ) आत्मीयता

एकात्ममानववाद की अन्तर्निहित प्रवृत्तियों में एकात्मता, समग्रता तथा पूरकता की विवेचना के पश्चात् उपाध्याय जी आत्मीयता का विवेचन करते हैं। उनके मत में पश्चिम की बड़ी असफलता यह है कि वह “स्वतन्त्रता” व “समानता” के दैवी भावों में समन्वय नहीं कर सका। वस्तुतः पश्चिम, अपने द्वारा ही घोषित तृतीय उद्घोष ‘बंधुता’ का कोई दर्शन उत्पन्न नहीं कर सका

<sup>12</sup> ऋग्वेद 1-164-20

<sup>13</sup> पातं न प्रथमं व्यवस्यति जलं युष्मास्वपीतेषु या  
नादत्ते प्रियमण्डनाऽपि भवतां स्नेहेन या पल्लवम् ।

आद्ये वः कुसुमप्रसूतिसमये यस्या भवत्युत्सवः

सेयं याति शकुन्तला पतिगृहं सर्वैरनुजायताम् ॥ अभिज्ञानशाकुन्तलम् 4/9

<sup>14</sup> उदगलितदर्भकवला मृग्यः परित्यक्तनर्तना मयूराः ।

अपसृतपाण्डुपत्रा मुञ्चन्त्यश्रूणीव लताः ॥ वही 4/12

। बंधुता का आधार सहानुभूति व आत्मीयता होती है जो जड़वाद के आधार पर अनुभव नहीं की जा सकती । “स्वतंत्रता, समानता व बन्धुत्व एक ही तत्त्व में अन्तर्निहित हैं, जिसे आत्मीयता कहते हैं”<sup>15</sup> मानव की आध्यात्मिक चेतना ही उसे समग्रता व पूरकता की दृष्टि देती है । इस दृष्टि का चेतन तत्त्व है आत्मीयता । हम किसी का “पूरक” बन कर उस पर एहसान नहीं करते वरन् अपने “आत्मीयजन” के सहयोग का सुख प्राप्त करते हैं । ‘सहानुभूति’ मानवता का गुण है, आत्मीयता के कारण सहानुभूति होती है । इसी आत्मीयता के भावस्वरूप व्यक्ति का स्व-पर का भेद विगलित हो जाता है तथा वह सम्पूर्ण विश्व को अपना कुटुम्ब समझने लगता है ।

अयं निजः परोवेति गणना लघुचेतसाम् ।

उदारचरितानां तु वसुधैव कुटुम्बकम् ॥

वह सबके सुख, कल्याण एवं मुक्ति की कामना कर पाता है ।

सर्वे भवन्तु सुखिनः सर्वे सन्तु निरामयाः ।

सर्वे भद्राणि पश्यन्तु मा कश्चिद्दुःखभागभवेत् ॥

इस प्रकार एकात्ममानववाद में “एकात्मता” केन्द्रीय प्रवृत्ति है । इसके विश्लेषण की निष्पत्ति के रूप में अन्य दो प्रवृत्तियों का जन्म हुआ । प्रथम है कि प्रकृति का एकात्मक चरित्र हमें “समग्रता” का संदेश देता है तथा एकांगिकता का निषेध करता है । “समग्रता” का संयोजन संघर्ष से नहीं, ‘समन्वय’ से ही हो सकता है । दूसरी प्रवृत्ति है कि समन्वय का आधार परस्परपूरकता एवं आत्मीयता है । निश्चय ही मानववाद का ये विचार भारतीय परम्परा एवं संस्कृति की चिन्तनधारा से प्रभावित दिखाई देते हैं जिसे दीनदयाल जी स्वयं स्वीकार करते हैं ।

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<sup>15</sup> दीनदयाल उपाध्याय:कर्तृत्व एवं विचार, डॉ. महेश चन्द्र शर्मा, पृ.430

मानववाद (एकात्म) के बीज किसी न किसी रूप में हमें वेद, उपनिषद एवं गीता में दृष्टिगत होते हैं, जिसकी युगानुरूप व्याख्या पं. जी ने की है। अस्तु, दीनदयाल उपाध्याय की मानववाद (एकात्म) की अवधारणा के दार्शनिक आधार के रूप में संस्कृत साहित्य को स्वीकार किया जाना चाहिए।

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## **RISK MANAGEMENT DISCLOSURES AMONG THE FINANCIAL INSTITUTIONS: AN OVERVIEW**

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### **Abstract**

*The global financial crisis has raised questions on the risk management disclosures of the financial institutions. As a result, the importance of adequate and transparent risk disclosures among the financial institutions has been exclusively highlighted. The paper discusses about the concept, need, benefits and the existing literature on Risk Management Disclosures. An adequate and timely risk disclosure help the stakeholders to make informed decisions and benefits the institution through improved reputation, enhanced confidence and improved communication to the stakeholders and lower financing cost. However, the existing literature provides evidence for inadequate risk disclosures being qualitative in nature. Hence, it is suggested that the qualitative risk disclosures should be supplemented by quantitative risk disclosures to be of relevance to the stakeholders in decision making. Moreover, regulatory bodies should enhance the risk disclosure requirements for the financial institutions by making it mandatory in nature.*

**JEL Classification:** G20, G32

## 1. Introduction

During the course of the operations, financial institutions are invariably faced with different types of risks that may have a potentially adverse effect on their business. These risks can negatively affect the institution and damage its reputation in the market. The major risk types among the financial institutions may be categorized as Credit risk; Market risk; Operational Risk; Liquidity risk; Interest rate risk and Other risk categories (example strategic and reputational risk). Risk management process in the financial institutions includes risk identification, measurement and assessment, monitoring and control with an objective to minimize the negative effects of risks on the financial result and capital of the financial institution. They are, therefore, required to form a special organizational unit in charge of risk management and required to prescribe procedures for risk identification, measurement and assessment, as well as for monitoring and control.

Management Accounting Guideline; AICPA (2006) clearly explains risk reporting as: “All process associated with communicating risks of a business to stakeholders. It can be broadly divided in to two areas - internal and external reporting. Internal risk reporting is where Organizational risks are reported to the management and board to support corporate decision-making. External reporting is where Organizational risks are communicated to external stakeholders like investors, potential investors, customers and financiers to help them make calculated decisions about their investments and continuity of business relationship. ” However, the present paper focuses on External Reporting referred to as Disclosure made to the external stakeholders.

Disclosures form the Pillar III of Basel Capital Accord. Pillar III — market discipline complements Pillar I (the minimum capital requirements) and Pillar II (the supervisory review process) of Basel Capital Accord. Pillar III defines the disclosure requirements an institution must meet which will allow market participants to assess key information on the capital adequacy of the institution. Basel Committee aims to encourage market discipline by developing a set of disclosure requirements which will allow market participants to assess key pieces of information on the scope of application, capital, risk exposures, risk assessment processes, and hence the capital adequacy of the institution<sup>1</sup>. This indicates the importance attached to the Risk Management Disclosures by the regulatory bodies.

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<sup>1</sup> BCBS International Convergence of Capital Measurement and Capital Standards: A Revised Framework (June 2004)

Moreover, the importance of Transparency in Risk Disclosures has been stressed upon by a number of commentators. Transparency is defined as the disclosure of all information that will ensure the proper accountability of institutions to their boards, investors, shareholders, regulators and other stakeholders<sup>2</sup>. Transparency of risk positions and risk management processes is very important to investors, clients and other stakeholder groups of financial institutions. For the effectiveness of market discipline, institutions need to make transparent disclosures. Economic Research - Federal Reserve Bank of San Francisco (2003) suggests that “banks must be sufficiently transparent; that is banks must provide a sufficient amount of accurate and timely information regarding their conditions and operations to the public”.

Risk Disclosures made to the External Stakeholders also forms an important element of a sound Risk Management Framework. Transparent Disclosures on the risk management positions and the risk management policies and practices implemented is required by the external stakeholders for the purpose of decision making. KPMG (2012) indicates that Supervisors; Auditors; Rating agencies; Clients and Shareholders are the External Stakeholders of the institution. Hence, it is essential that financial institutions adequately and timely disclose their practices and policies with respect to Risk Management to their stakeholders.

## **2. Types of Risks –**

The basic constituents of a risk management system are risk identification of the risks that an institution is exposed to, risk assessment, risk monitoring and risk mitigation. Hence, understanding the different types of risks is essential. These include:

1. Credit Risk - Credit risk also called as the default risk which involves failure of a customer or counterparty to meet its obligations in relation to lending, trading etc. It includes prediction of the possibility that the customer will pay back the loan amount and interest.
2. Market Risk - Market risk is the risk of losing value on financial instruments because of adverse changes in the prices of equities, interest rates, commodity prices, and foreign exchange changes.

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2 The role of transparency in the financial Sector by Transparency International; EU Office; Group of Experts on Banking Issues (GEBI) dated 01 June 2011

3. Operational Risk - Operational risk has been defined by the Basel Committee on Banking Supervision, “as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events.”
4. Liquidity Risk – It may be defined as the risk that an institution will not be able to meet its contractual obligations because of inadequate liquidity (amount and composition of funding).
5. Capital risk – It is the risk that an institution has an insufficient capital in terms of level and composition to carry out its business operations.
6. Country risk – It is the risk that a sovereign event causes changes to the value of contractual obligations, adversely affecting the markets of a particular country.
7. Compliance risk - It is the risk of failure to compliance with the existing applicable rules and regulations.
8. Conduct risk - It is that risk that arises because of an employee’s actions negatively affecting the institution causing harm to its value and reputation.
9. Legal risk - It is that risk arising from imposition of damages, penalties or other liabilities of the firm arising from non compliance of rules and regulations.
10. Model risk – It is the risk of loss from adverse consequences of decisions based on incorrect model outputs.
11. Reputation risk – It is the risk of losses arising from adverse effects to the reputation of an institution.

Hence, there is variety of risks faced by financial institutions and the institutions should clearly indicate how they are managing these risks through appropriate risk management disclosures in the annual report.

### **3. Risk Management Structure-**

As suggested by Reserve Bank of India, the organizational structure for a risk management function shall comprise of the following:

1. Board of Directors
2. Risk Management Committee of the Board
3. Risk Management Committee
4. Risk Management Department
5. Risk Managers
6. Support Group for Risk Management

It is the responsibility of each of the financial institutions to create a successful Risk Management Structure to effectively manage the risks faced.

### **4. Need for Risk Management Disclosures**

The recent financial crisis has greatly emphasized the importance of adequate and transparent risk disclosures among the financial institutions. Transparent risk disclosures encourage the financial institutions to function in a safe and sound manner as well as enhance the confidence levels of investors in the market. Enforcing transparent risk disclosures can lead to system stability and minimize the probability of systemic crisis among the financial institutions. Further, Management Accounting Guideline, AICPA (2006) also emphasizes that stakeholders require increased corporate disclosure so as to take more informed decisions.

As suggested by KPMG (2008), 'if the quality of risk management systems in an institution is poor, then it is likely that the risk disclosure will be inadequate; however when risk management systems in place are effective, adequate risk disclosures help in gaining market confidence<sup>3</sup>. This

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3 Financial Institution Risk Disclosure Best Practice Survey; KPMG(2008)

indicates that sound risk management systems enhance the quality of risk disclosures whereas inadequate disclosures point out towards the inferiority of the risk management systems put in place by the institutions. In other words, risk disclosures signal about the soundness of risk management systems employed by the institutions. Thus, Risk Disclosures provide an insight into the risk management policies and practices adopted by the institutions.

Jaime Caruana, [General Manager, Bank of International Settlement] in a Keynote speech on 'Financial Stability and Risk Disclosure' (December 2011) indicates that quality risk disclosures are good for markets, for the prudential supervisors and also for financial stability, as it decreases the effects of unexpected events.

Further, prior literature on risk disclosures provides enough evidence of a strong relationship between financial institutions' system stability and level of risk disclosures. Cordella and Yeyati (1998) reveal that the likelihood of banking crisis is less where there are higher transparency and regulatory disclosures. Nier (2005) provides evidence of positive effects of transparent disclosures on banking stability. Tadesse (2006) proves that mandatory disclosures are strongly associated with banking system stability. Homolle (2009) concludes that risk reporting does not generally decrease bank's risk exposure or lessen the probability of bank runs, but may lead to an increase in insolvency risk of risky banks. Hence, the previous research studies confirm that transparent risk disclosures lead to financial institutions' system stability. Thus, risk management disclosures are essential for financial institutions for a Stable Environment.

For all the above reasons, risk management disclosures are essential. Thus, financial institutions should provide appropriate, adequate and timely disclosures to the various stakeholder groups. Moreover, the regulatory body should ensure that these institutions make adequate risk disclosures relevant for all the stakeholders.

## **5. Benefits of Risk Management Disclosures**

A variety of benefits accruing from Risk Disclosures are reported through the existing literature and reports of global consultancy companies. These sources include KPMG Financial Institution Risk Disclosure Best Practice Survey (2008); Management Accounting Guideline, AICPA (2006); KPMG Business Dialogue, Operational Risk (2012) and Keynote speech by Jaime Caruana on 'Financial Stability and Risk Disclosure' (December 2011). The Benefits comprise of:

- 1.) Compliance with the Regulation – The third pillar of Basel Framework i.e. market discipline requires the financial institutions to make adequate risk disclosures allowing market

participants to make informed decisions. To promote market discipline, regulators want timely and sufficient disclosures from the financial institutions. Hence, by making adequate risk disclosures, financial institutions are able to comply with the regulation and decrease their costs of regulatory penalties.

- 2.) Enhanced Reputation – Financial Institutions providing adequate risk disclosures enjoy increased reputation with regard to their competitors. A strong reputation is the biggest asset of the bank. Management Accounting Guideline on Risk Reporting, AICPA (2006) suggests that institutions are able to benefit from Risk Disclosures to stakeholders in the form of increased sales from existing and new customers, staff retention and enhanced recruitment.
- 3.) Maintains Market Confidence – Adequate disclosures to the stakeholders helps in sustaining the confidence of the stakeholders in the institution. This leads to earnings stability and hence increases the shareholders' value. Thus, adequate risk disclosures lead to valuation efficiency.
- 4.) Lower Cost of Capital – Enhanced reputation reduces the cost of equity funding for the institutions and, thus, benefits the institution in the form of reduced financing cost.
- 5.) Promotes Market Discipline – Risk Disclosures promote market discipline and helps the investors to make more informed decisions.
- 6.) Managing Reputational Risk – Providing accurate and timely risk disclosures lessens the institutions' exposure to reputational risk. This is because disclosures minimize the shock from unexpected information.
- 7.) Improved communication to the external stakeholders – Institutions are able to communicate their risk management practices and policies to the external stakeholders by the way of adequate risk disclosures.
- 8.) Increased accountability to the Supervisors – Adequate risk disclosures make the financial institutions more responsible for their actions to the supervisory bodies and other stakeholders.
- 9.) Leads to Financial stability – Risk Reporting promote stability among the entire financial system.

## 6. Literature Review

A number of studies have examined the issue of disclosure of risk information in the annual reports of financial as well as non financial institutions. Although, Basel Committee was the first to study the Risk Disclosures made by banking institutions in their annual reports, thereafter, a number of research studies examining various Risk Disclosures of financial as well as non financial institutions and the factors affecting these disclosures appeared. These studies have been carried out for diverse risk categories covering different countries and differing periods of study. A summary of these studies is presented in Table 1:

**Table 1: Summary of Studies on Risk Disclosures**

<b>Author (s) and Year</b>	<b>Disclosure Category</b>	<b>Method, Period and Sample for Study</b>	<b>Main Findings</b>
Basel Committee on Banking Supervision (2001); [similar studies carried out in 2002 & 2003]	Overall Risk Disclosures	Survey of annual reports; annual reports- 1999; 57 internationally active banks	Lack of disclosures with regards to credit risk modelling, use of internal and external ratings, derivative and securitization; disclosure levels above 60% for operational, interest rate and liquidity risks
Beretta and Bozollan (2004)	Voluntary Risk Disclosure	Content Analysis Approach, Disclosure Index and regression; annual reports- 2000; 85 non financial companies listed on Italian Stock Exchange	Disclosures reported are narrative; firms' voluntary disclose the future strategies but not about their expected impact; disclosures biased towards management's self-justification; firms prefer to disclose management's future expectations rather than conveying the risk management decisions and actions taken
Lajili and Zeghal (2005)	Overall Risk Disclosures and Risk Management Information	Content Analysis Approach and regression; annual reports- 1999; TSE 300 Canadian companies	Risk information disclosed is almost qualitative in nature; located in the notes to the financial statements and/or in the MD&A; most frequently cited risk categories are financial risk, commodity and market risk; risk disclosures lack valuable quantitative insights
Helbok and Wagner (2006)	Operational Risk Disclosures	Content and Extent Analysis, Disclosure Index and random effects ordered logit model; annual reports: 1998 to 2001; 59 banks covering North America, Asia and Europe	Both extent and content of banks disclosure increased substantially; institutions with lower equity ratio and /or are less profitable choose higher levels of operational risk disclosure.
Linsley and Shrives (2006)	Overall Risk Disclosures	Content Analysis using risk disclosure sentences	Positive significant correlation between risk disclosures and



Author (s) and Year	Disclosure Category	Method, Period and Sample for Study	Main Findings
		and Pearson correlation and Wilcoxon signed ranks test ; annual reports: 2000; 79 non-financial firms listed within FT-SE 100 Index	company size and risk disclosures and level of environmental risk; no association between risk disclosures and gearing ratio, asset cover, quiscore, book to market value of equity and beta factor
Sundmacher and Ford (2006)	Operational Risk Disclosures	Content Analysis Approach, Disclosure Index; annual reports:2004 & 2005; 57 internationally active banks across 5 countries	Quantity and quality of operational risk disclosures vary significantly across institutions; disclosures are descriptive in nature and need to be supplemented by quantitative information in order to be useful
Abraham and Cox (2007)	Narrative risk information comprising of business risk , financial risk and internal control risk reporting	Content Analysis Approach and regression; annual reports: 2002; 71 firms listed on FTSE 100 index in UK	Pattern of risk disclosures depend upon the form that reporting regulation takes; corporate risk reporting is negatively related to share ownership by long-term institutions and positively related to independent directors
KPMG (2008)	Bank specific (credit, market and ALM risk); insurance specific (insurance, investment & ALM & liquidity risks); common risk (business risk, operational risk and overall risk and capital strategy)	Content Analysis Approach, Disclosure Index; annual reports:2007; 25 European banks and 14 insurance companies	Higher levels of risk disclosure in banking sector than insurance sector; regulation is an important driver for risk disclosure; Poor structure and lack of forward looking information reduces the quality of risk disclosures
Woods (2008)	Market Risk Disclosures	Content Analysis Approach, construction of score sheet; annual reports: 2000, 2003 & 2006; world's top 25 banks	Diversity in the market risk disclosure practices, both numerical and narrative; that is why progress towards international harmonisation remains apparent with regards to market risk disclosures; no relation between the level of disclosure and bank size
Hossain (2008)	Overall risk disclosures	Content Analysis Approach; Disclosure Index and regression; annual reports: 2003; 38 listed banks in India	Higher compliance to mandatory disclosure and lower compliance for voluntary disclosures; size, profitability, board composition, and market discipline are significant in explaining the level of disclosures, whereas age, complexity of business and asset-in-place are insignificant in explaining disclosures

Author (s) and Year	Disclosure Category	Method, Period and Sample for Study	Main Findings
Hassan (2009)	Corporate risk disclosures	Content Analysis Approach; Disclosure Index and regression; annual reports: 2005; 41 listed UAE corporations	Insignificant relationship between corporate size and level of disclosure and reserves; level of risk and industry type are significant in explaining disclosures
Oorschot (2009)	Market, credit and liquidity risk disclosures	Content Analysis Approach; Disclosure Index (disclosure quality and disclosure quantity framework) and regression; annual reports: 2005–2008; 8 German banks	Regulation (GAS 5-10, IFRS 7) is the main driver for the increased disclosures for German banks; not the size and profitability of a bank
Oliveira, Rodrigues and Craig (2011)	Voluntary disclosure of operational risk and capital structure and adequacy	Content Analysis Approach; Disclosure Index and regression; annual reports: 2006; 111 Portuguese banks	Low levels of disclosure; public visibility (assessed by size and company listing status) and reputation (assessed by company age, depositor confidence level, and company risk management abilities) significantly affect disclosures
Hemrit and Arab (2011)	Operational risk disclosures	Content Analysis Approach; Disclosure Index and regression; annual reports: 2000-2009; 14 Tunisian insurance companies	Substantial increase in disclosure levels; significant relationship between disclosures and size, intensity of provisions & leverage; insignificant relationship between disclosures and profitability & cost of capital
Haija and Hayek (2012)	Operational risk disclosures	Content Analysis Approach; Disclosure Index; annual reports: 2010; 12 Jordanian banks	Content of Jordanian banks' disclosure on operational risk is substantially good but primarily meets the requirements of Central Bank of Jordan which are not enough as compared to BCBS
Barakat and Hussainey (2013)	Operational risk disclosures	Content Analysis Approach; Disclosure Index and two stage random-effects model with generalized least squares (GLS); annual reports: 2008-2010; 85 European banks	High variation in disclosure quality; banks with higher proportion of outside board directors, lower executive ownership, concentrated outside non-governmental ownership, more active audit committee and operating under less stringent entry to banking requirements provide higher quality of operational risk disclosures
Ismail, Rahman and Ahmad (2013)	Overall Risk Disclosures	Content Analysis Approach; Disclosure Index; annual reports: 2006-2009; 17 Islamic	Risk disclosure has greatly improved from around 80% to more than 90%; hence Islamic financial institutions have enhanced

Author (s) and Year	Disclosure Category	Method, Period and Sample for Study	Main Findings
		financial institutions in Malaysia	their disclosure considerably
Hassan (2014)	Overall Risk Disclosures	Content Analysis Approach; Disclosure Index and regression; annual reports: 2006-2010; 27 Egyptian listed companies	Low level of improvement in disclosure quality; disclosures are relevant and understandable to some extent but less comparable and verifiable; firm size and leverage are the most important determinants of disclosure quality
Buckby, Gallery, .and Ma (2015)	Overall Risk Disclosures	Content Analysis and Regression Analysis; 300 Australian Securities Exchange -listed companies by market capitalisation	Widespread divergence in disclosure practices; low conformance with the Principle 7 of the ASX Corporate Governance Principles and Recommendations. Also companies do not disclose all “material business risks”
Raemaekers, Maroun and Padia (2015)	Overall Risk Disclosures	Content Analysis; annual reports 2010-12; few large firms listed on the Johannesburg Stock Exchange	Increase in disclosure over the period; possibility of reporting on the governance of risk being a compliance-based exercise rather than an effective stakeholder communication
Jia, Munro and Buckby (2016)	Overall Risk Disclosures	Semantic content analysis; annual reports 2010-12; 100 Australian Securities Exchange (ASX) listed companies	Disclosures are considerably lacking in quality, from the dimension “quantity”, “width” and “depth” dimension and sub-dimensions
Kakanda, Salim and Chandren (2017)	Overall Risk Disclosures	Content Analysis Approach; Disclosure Index; annual reports 2012-15; 45 listed financial service Nigerian firms	Significant disclosure w.r.t. risk management committee structure and its responsibility, risk management policies, audit committee availability and function, and capital/market risks
Rujjina and Sukirman (2020)	Enterprise Risk Management Disclosures	Content Analysis and Regression Analysis; annual reports 2013-17; manufacturing firm registered on Indonesia Stock Exchange	Firm size and firm age have significant positive effect on enterprise risk management disclosure, while leverage, profitability, domestic institutional ownership structure, foreign ownership structure, local individual ownership structure had a significant negative effect
Nahar and Azim (2022)	Executives' perceptions of risk management disclosures	Semi-structured in-depth interviews with 36 executives involved in risk management disclosures, policy-making	Corporate risk management disclosures still at a low level.; reasons for non-disclosure may be related to institutional weaknesses, lack of disciplinary action and

Author (s) and Year	Disclosure Category	Method, Period and Sample for Study	Main Findings
			political interference

The above studies may be segregated as studies examining the overall risk disclosures and studies examining disclosure of a specific risk type. The studies based on overall risk disclosures [eg. BCBS (2001); BCBS (2002); BCBS (2003); Beretta and Bozollan (2004); Lajili and Zeghal (2005); Linsley and Shrives (2006); Hossain (2008); Hassan (2009); Ismail, Rahman and Ahmad (2013); Hassan (2014); Raemaekers, Maroun and Padia (2015); Raemaekers, Maroun and Padia (2015); Jia, Munro and Buckby (2016); Kakanda, Salim and Chandren (2017)] provide evidence for the qualitative nature of overall risk information. The remaining studies relate to the disclosure of specific risk type [eg. Sundmacher and Ford (2006); Helbok and Wagner (2006); Abraham and Cox (2007); KPMG (2008); Woods (2008) and Oorschot (2009); Oliveira, Rodrigues and Craig (2011); Hemrit and Arab (2011); Hajia and Hayek (2012); and Barakat and Hussainey (2013) and Rujjina and Sukirman (2020)]. These studies examine the disclosure quality and the factors affecting the disclosures on various risk categories. Majority of these studies also observe that risk disclosures are descriptive but regulation is an important driver for risk disclosure. However, with regards to the determinants of disclosure on various risk categories, mixed results have been observed. On the whole, size; profitability; age of the institution; leverage; effective Audit Committee among others are important factors affecting quality and quantity of risk disclosures among financial institutions.

## 7. Conclusions

The disclosures on Risk Management are important in understanding the strength of Risk Management Framework and the associated policies and practices employed by the institutions. The stakeholders of the institution are able to assess its ability to effectively manage various risks and, hence, make more informed decisions. The benefits of adequate and timely risk disclosures to the institution include improved reputation, enhanced confidence of stakeholders, improved communication to the stakeholders and lower financing cost.

On examining the existing literature, it is evident that the risk management disclosures among the financial institutions are predominantly descriptive in nature [Beretta and Bozollan (2004); Lajili and Zeghal (2005); Linsley and Shrives (2006); Hossain (2008); Hassan (2009); Ismail, Rahman and Ahmad (2013); Hassan (2014)]. The findings also indicate inadequacy of operational risk

disclosures [Sundmacher and Ford (2006); Oliveira, Rodrigues and Craig (2011); Hajia and Hayek (2012) and Barakat and Hussainey (2013); Buckby, Gallery, and Ma (2015); Jia, Munro and Buckby (2016)]. It is observed that the quality of risk disclosures is dependent upon the Reporting regulations in the country. Moreover, the quality and quantity of risk disclosures varies significantly across financial institutions in a country.

Therefore, it is suggested that the qualitative risk disclosures should be supplemented by quantitative risk disclosures to be of relevance to the stakeholders in decision making. It is also recommended that the regulatory bodies should enhance the risk disclosure requirements for the financial institutions by making it mandatory in nature. This will help in ensuring better quality and quantity of risk disclosures among the financial institutions.

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## A CASE STUDY ON THE IMPACTS OF ONLINE MODE OF LEARNING ON EDUCATION

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### **ABSTRACT**

*The impact of the pandemic upon the human world has been multi-dimensional. In retrospect, the disruption of human life caused by the pandemic can be aptly described as unprecedented. Human organizations were forced to undergo changes of a phenomenal nature within a very short span of time in order to brave the reeling impacts of the covid spread. The article looks at one such core areas of human life namely education. The field of education has always been dynamic, known for its adaptability to changing circumstances and contexts. The progressive developments within the said field are a witness to human spirit of persistence and strive for excellence. However, it cannot be denied that the foundations of education systems all of the world have been rather severely undermined since the advent of the pandemic. Educational institutions were forced to shut down which caused unimaginable damage to the academic world of teachers and students alike. Globally, the educational systems were forced to introduce several changes, whenever they could, in order to maintain the fleeting appearance of the pre-covid times, with far limited success. The article delves into these very aspects of disruption and change within the educational system in India. Through primary research among the students of Mata Sundri College for Women, the article aims to unearth the impacts of the online mode of teaching-learning processes- a somewhat novel attempt within the field- upon the over-all quality of education.*

### **INTRODUCTION**

Equality of opportunity to all is one of the basic principles of our Constitution, and its significance to make education an achievable goal for all, cannot be emphasized enough. John Dewey, American philosopher, psychologist, and educational reformer, strongly argued that “[A]n environment in which some are limited will always in reaction create conditions that prevent the full development even of those who fancy they enjoy complete freedom for unhindered growth” (Dhankar, A.,2021). Another point he strongly supports is that for good education, one must lead the child’s current interests and abilities organically to logically organized human knowledge. This second point is a reference to the quality of education.

Education is empowering and redefining. For hundreds of millions of the young in India, education is also about discipline, development, curiosity, creativity and a path to breaking the cycle of ignorance and poverty leading to employment and prosperity. According to Vivekananda,

"What is education?

It is a book- learning? No

Is it diverse knowledge? Not even that.

The training by which the current and the expression of will are brought under control and become fruitful is called education” (Swami Vivekananda)

Ever since the widespread coronavirus knocked India in March 2020, the Prime Minister of India issued immediate orders to shut schools and colleges in order to protect the students from the deadly disease. Since education of students could not be kept shut for a very long duration, the only crisis-driven solution appeared to be the shift to online mode of teaching-learning. Classes and examination shifted to online mode. Since its very inception, there has emerged a raging debate concerning the merits and demerits of digitized education. While on one hand, there is an opinion which extends its gratitude to the fact that despite the global lockdown, the processes of education continue with the aid of technology, and even sees this opportunity- even though a forced one- for the much-needed upgradation of the quality of education through digitalization and e-learning, on the other, there is another dominant voice which cries foul over the severe condition of digital-divide that exists in many countries, especially the developing ones.

The latter fear that the model of e-learning may not be a realizable goal for poorer societies, making education even more a matter of privilege than before. The current research aims to probe further into the stated merits and demerits of online education.

The COVID crisis has shown that hoping for the best does not help. We must plan for the worst and hope for the best. Education is in crisis at the moment. Our answer to the crisis in education during the pandemic has been to offer online education or education through digital platforms. However, there are serious issues related to access, availability of devices, content curation, teachers training, testing, exams, grades, funding, facilities, salaries, parents and fees. The worst affected, as always, will be the marginalized, rural and poor populations.

Digital education is not about videos of lectures on blackboards by teachers on the internet. It is about appropriate platforms, technology, tools, interactivity, curation, content and a lot more. We are completely unprepared. Government schools and colleges do not have the resources to provide digital education. Private schools and colleges are no different. The financial model of education has fallen apart everywhere during this pandemic. In India, the situation is even more complex because of the lack of a proper policy on digital education, infrastructure and multiple languages.

The government began planning for the students of the country only by the end of August in the previous year. Many analysts viewed these plans as mere rhetoric that is always served to the poor. These plans were based on presumptions like semi-literate or illiterate parents teaching their wards, community involvement, mobile pools, and so on. Anyone with an understanding of the dynamics of the urban-rural divide in India will immediately note these presumptions to be fallacious. As a

result, what becomes apparent is that online or digital education is accessible to only students with the required resources that include the basic precondition of access to money, electronic gadgets and knowhow of technology. Thus, digital India may become even more unequal and divided than it already is.

Listening to lectures on the mobile phone, copying from the board where the teacher is writing, frequent disconnections and/or having blurred video/audio can hardly organically connect the student's present understanding with the logically organized bodies of human knowledge. Even the examination has shifted to online mode now which gives students a chance at malpractices while writing their answers, which in turn affects their future, as the students are just going to get the degrees but not build knowledge. Even if the format of the questions is changed and we call it Open Book Examination, still the problem remains the same and the students do not get the same competitive environment as before.

Information Technology has been presented as a harbinger of a revolution in education for more than three decades now. However, all reliable studies seem to indicate that Information and Communication Technology (ICT) in the classroom helps in already well-functioning systems, and either has no benefits or negatively impacts the structurally lacking systems. The importance of the institutional environment cannot be emphasized enough in the current times of online teaching. Even when the institutions function sub-optimally, students themselves create an environment that supports their growth morally, socially and intellectually, through conversations and interactions with each other. The online mode of teaching completely forecloses this opportunity.

In the current research, the attempt is to delve into the experiences of the students of Mata Sundri College for Women with the digitized form of teaching- learning in the lockdown period; whether this rapid transition of old traditional classroom-based learning to digital e-classrooms has been done smoothly or students faced hardships from it. The research broadly aims to understand both the physical and mental impact of pandemic in their lives especially with reference to academics. Learning and studying can be immensely enjoyable and creatively engaging activities, if they are well arranged and supported. Is online mode really a beneficiary step towards quality education or another immense pressure upon an education system that is already structurally frail?

## **RESEARCH FINDINGS**

COVID-19 has resulted in educational institutions being closed down for physical access, all across the world. A global estimate says that over 1.2 billion children are out of the classrooms owing to the pandemic situation. A resultant adaptation on the part of few educational institutions has been to shift to online modes of teaching and learning. It can only be concluded that such a shift must have

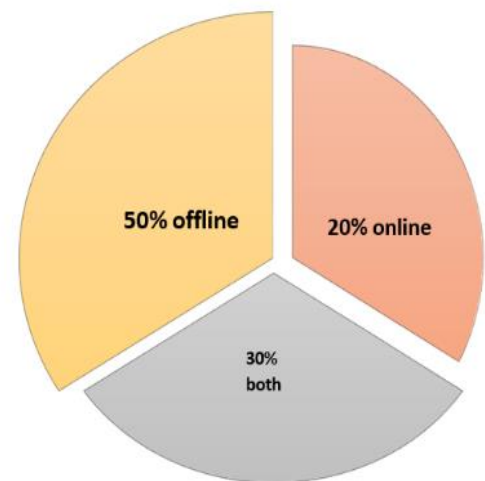
induced dramatic changes in education, with the distinctive emergence of e-learning, whereby teaching is undertaken remotely through digital platforms.

Many researches on the proliferation of e-learning have come up, and few suggest that online learning has been shown to increase retention of information by the students, and takes less time. With this sudden shift away from the classrooms in many parts of the globe, some wonder whether the adoption of online learning will continue to persist in the post-pandemic world as well, and how such a shift would impact the worldwide education sector.

With an intention to probe similar questions, the research conducted invoked varied responses. The respondents included 113 students, enrolled in various undergraduate courses at Mata Sundri College for women, aged 18 and older. Before the College was closed down in the month of March, year 2020 as a response to the contingent health crisis, these students were taking different college courses through physical or in-person class sessions. Thereafter, the students completed the rest of the sessions via the online mode.

The findings of the research are as follows. To the first question related to the preference of the students for online mode of teaching-learning, the research learnt that 50 percent of students gave preference to offline mode while 20 percent put stamp on the online mode.

According to Encyclopedia.com, “online education is a flexible instructional delivery system that encompasses any kind of learning that takes place via the internet. Online learning gives educators an opportunity to reach students who may not be able to enroll in a traditional classroom course and supports students who need to work on their own schedule and at their own pace.”<sup>13</sup> The new normal has led people, not just in India, but world over, to rely heavily on speedy internet connections, and electronic gadgets like computers and smartphones to go about their business. The crisis has nudged students to pick up e-learning opportunities as there is no end in sight. As the country takes to online education, the current pandemic is impacting rural students more than those who live in cities. Unfortunately, students in rural India are denied the newest devices and levels of accessibility to online content that urban Indians enjoy daily. Unlike their counterparts in cities, a lower percentage of students in villages possess desktop or laptop computers. They depend on their family members’ mobile phones for learning and attending classes, making it an arduous exercise. Watching small screens to consume as much information as possible for long hours could be



detrimental to students' health. For the students living in rural areas, purchasing data plans for learning could also incur a lot of expenses for families who face financial constraints. It could further affect the participation levels of both teachers and students in online classes. In all, lack of digital literacy as well as the digital divide have been serious concerns for our country for a long time. Many teachers and students in rural areas are not able to match up to the technical skills of educationalists and students in cities.

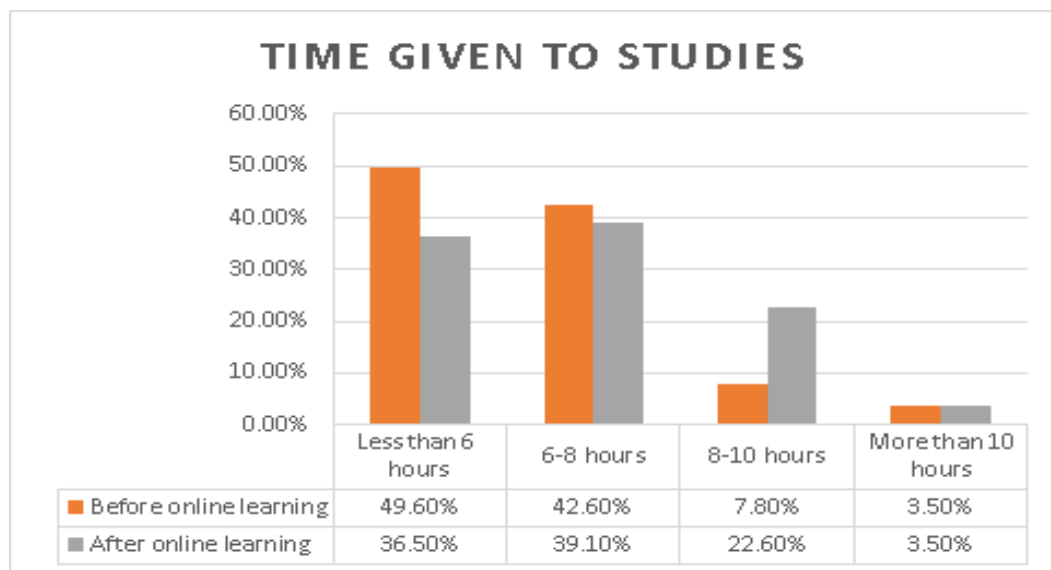
The research showed that out of the total strength of the respondents, 65 percent students were taking classes from metropolitan cities while 28 percent were located in towns and the remaining 12 percent in the villages, from where they pursued online education.

There is no denying that COVID-19 has turned the world upside down. As the world searches for new strategies to cope with this pandemic and its aftermath, higher educational institutions are now looking at online teaching-learning as a window of hope. Since a very long time, it has been claimed that as a considerable addition to classroom learning, engaging in different online learning modalities can introduce

students have new opportunities to access knowledge, while at the same time, break the mold of traditional classroom setting.

Several positive features of online mode of learning have been highlighted over the time. Online learning can be carried out in several ways like live online classes, recorded lectures, online educational resources, webinars, podcasts, etc. Students can learn at a time convenient for them, as they are not bound by strict timetables and schedules. Recorded lectures can be accessed at any time to read and revise. Online learning has the potential to make students independent and self-motivated.

To assess the above mentioned claims, the respondents were asked to specify the changes they have noticed in their routine of study before and after the pandemic. The results were as followed:



The data indicates that there has been a downfall in the time given to studies (both the online classes as well as self-study) by the respondents. The attention span of students in the online mode, especially in the asynchronous mode, is unpredictable. Moreover, a majority of students attended their classes via their mobile phones, because of which, it was nearly impossible for them to stay attentive. The mental stress because of the fear of loss/inaccessibility or breakdown of the device was very clear. The tendency to drift off was high amongst the respondents and the lack of audio-visual feedback from the students proved to be problematic for the teacher. The psychological impact of staying locked inside the house for over a year is also an issue due to which students are struggling to focus on their studies. But a small section of

students believed that due to online education, they could study for longer periods of time (8-10 hours). Because classes could be taken from home or location of choice, there were fewer chances of students missing out on lessons, and, additionally it saved time as well as resources spent on traveling to college.

It can be said that each student has a different learning style. Some students are visual learners, while others prefer to learn through the audio medium. Similarly, some students thrive in the classroom, while others have a preference for self-study, as being part of large groups or classrooms distracts them. The findings suggest that while an online learning system, with its range of options and resources, can be personalized, and help to create a perfect learning environment suited to the needs of each student, the range of problems invoked in such a context that adversely impact the ability of the students to learn, cannot be ignored.

Related to above findings, the research sought to know whether the respondents had a conducive environment at home to pursue online learning. Based on the data received, it was evident that only 53.9% of the respondents viewed their home condition as being conducive to the pursuit of online learning whereas, a good 46.1% people did not have such privilege. The home environment is not always favorable for students to learn — either because it's very noisy or because it is sensitive: not all students can switch on their video, even if they have the bandwidth, as the domestic circumstances might not be something that they want to show and many more such reasons.

Educational institutions have been among the hardest hit by the COVID-19 lockdown. Overnight, they were forced to consider a new medium, which had been supposedly only an experimental endeavor till then. In the typical higher education model, classes are held in a physical environment, usually through lectures. However, in the days of lockdown, students take classes from the more familiar and supposedly comfortable home environment but perhaps come across challenges that anyone running a home office would face — balancing home responsibilities with the rigors of being in a classroom. These range of challenges, as the data puts across in the latter part, are unprecedented and a serious source of concern for the students.

The following part focused on assessing the home conditions from where the respondents pursued online classes. To the query whether the respondents were the single members within their families to be pursuing online classes, the data suggested that out of the 115 respondents, only 32 were the sole members taking online classes from home, while a whopping 83 respondents shared the provisions/resources for online pursuit of classes with at least one other



sibling or member of the family. On this basis, the research also came across several problems that the latter share of respondents must be facing as the resources at home get divided amongst more than one contender for online learning. These problems, as have been extrapolated by the findings further, can be many, ranging from disturbance faced due to less space at home or not having access to more than one device to take classes, resulting in the failure of one member attending his/her lectures.

To the question whether the respondents owned an electronic gadget like a personal computer, or laptop, or a mobile phone to take online classes, the data showed that a close to 14 students did not own any of these devices to be able to join classes. While this number might appear to be insignificant as compared to the majority 101 students who had access to the same, it must be asked if in a scenario, where no device to take online classes means zero access to education, in what manner do we assess the situation and the fate of the respondents who faced an abrupt halt in their education process because of the inaccessibility of a crucial resource? Where do they stand and can they be viewed as mere casualties of a new system, lest it continues in the post- pandemic world as well?

#### Personal Ownership of Electronic Device

Yes (101)

No (14)

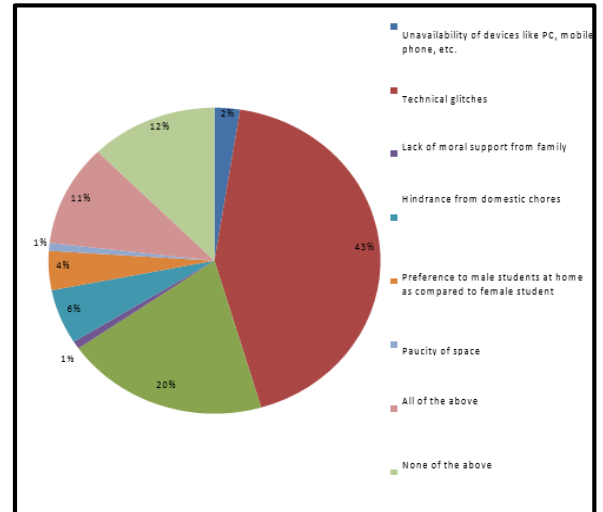
The next part dealt with a very crucial question of the different problems faced by the respondents while taking online classes. The findings were quite revealing as they open our eyes to a world of issues that the students tackle with, on a daily basis, while struggling to pursue education via the online mode.

Here are some of the most common challenges, as informed by the respondents while taking online classes:

- Technical issues.
- Distractions and time management.
- Staying motivated.
- Understanding course expectations.
- Lack of in-person interaction.
- Adapting to unfamiliar technology.
- Uncertainty about the future

The findings are as follows:

From the data, it was amply clear that the online mode of learning constituted a host of problems from the students. Merely owning an electronic device to access class was not enough in itself. The category of ‘technical glitches’, which posed a major hindrance in the process of smooth participation in class, was faced by a whopping 43 percent. It is very clear that in a system that is technology-dependent, technical glitches can go a long way to act as a significant disruption in the process of teaching-learning. Data also suggested



that there were various other issues faced by the students like lack of space to take classes, resulting in zero privacy, which in turn impacted the students' capacity to concentrate. There appeared to be students who had problems in attending the classes because the background environment was not education-friendly or conducive to pay the required attention to online lectures, which in the end, impacted their overall performance. In addition, the data also highlighted another major issue, especially mentionable in the context of female students, who had to struggle against patriarchal mindset at home, which did not give due importance to online mode of learning for females in comparison to male members of the family. Such a discriminatory attitude appeared to be faced by a certain percentage of the respondents, which controlled the latter's access to internet resources, gadgets and above all, free time devoid of pressures of domestic chores, to be able to take online classes.

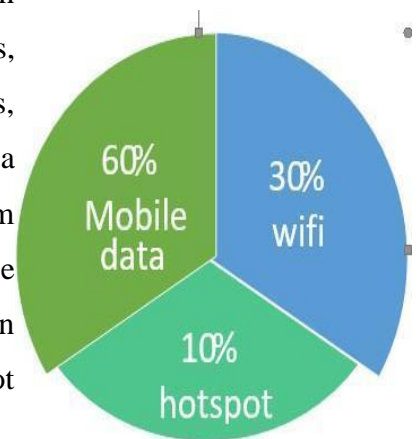
The research delved further into examining the background conditions in which the students pursued online classes. To the question if the respondents had access to a separate room/space to take online classes, it was found that nearly 40 percent reported a lack of access to quiet room/space to study.

Online classes seemed a perfect solution once the nation went into the initial phase of the 21-days lockdown to contain the COVID-19 spread, until issues like poor connectivity, shortage of smartphones surfaced. The pandemic was enough to derail the education system of India and now, poor internet connectivity and shortage of smartphones are creating hindrance for the students. Not only the students and teachers residing in the remotest parts of the country, face issues related to internet availability as well as connectivity, but also those who reside in megacities. The non-urban areas have also been hit massively by these issues. A query on the accessibility of internet facilities, revealed that as good as 65 percent of the respondents could

access glitch-free internet only at certain times, while 25 percent only replied in affirmative. Owing to this problem, the respondents reported recurring problems of wastage of time, and lack of motivation to join online classes.

The data showed that 60 percent of respondents connected through mobile data, which did not often last to cover nearly 3-4 hours of lecture. The classes were conducted mostly via Zoom or Google Meet platforms, and many respondents, owing to poor connectivity and server issues, faced the problem of paused or frozen video, by the time they resumed, they reported having missed out a part of the live sessions. The situation appeared to be worse for those from remote, non-urban areas.

This clearly highlighted India's digital divide, and that poor connectivity and lack of smart gadgets were indeed a hassle for many respondents. It was also a concern among the respondents that increased data consumption affected the family budget in adverse ways. From the data, it was found out that many of the respondents' families did not have a wi-fi connection prior to the lockdown period. As a result of classes getting shifted to the online mode, some of the families purchased either the broadband connection while some of them remained dependent on extra data booster packs, which constituted extra expenditure on mobile data. In many families, more than one internet connection was required, where, in addition to a school or college going sibling, at least one member had to work from home. Respondents reported that earlier the 1.5 GB data used to suffice but now, a huge elevation on data was seen. Some students even complain of increased expenses on purchasing books as earlier they got books from the library for free or nominal fee.



64.3% of the family members were found to be supportive towards this new mode of online teaching and learning process. Understanding the need of the hour due to widespread coronavirus pandemic when no one could step out of their houses, schools and colleges were running in online mode, where most of the parents were found cooperating with their children. At the same time, the data also suggested that 23.5% of the respondents' guardians found this new approach to learning a complete waste of time and resources. The remaining 18.3% respondents reported no particular response of their parents/guardians to this situation.

When asked about the changes witnessed, if any, on the quality of education, 73.8% of the respondents thought that the online mode of learning has impacted the quality of education. Though the teachers, syllabus and books/reading material remained the same as before, the

respondents observed a decline in their devotion towards studies because of the classes taking place on online platforms. The respondents were informed that it was difficult to concentrate on the mobile screens for hours. Also, most respondents complained of lack of proper environment for studying, especially those resources which were otherwise available at college like the library, practical rooms, laboratories etcetera. In addition, the online mode of learning was restricted to books only, while at the same time, being devoid of the significant aspect of face-to-face and regular interactions with classmates/ friends and teachers. The respondents felt that the competitive, academic environment of physical classes could never be substituted by the online mode of interaction.

So, how were the respondents impacted while attending online classes?

In the research, a combination of mixed reactions from the students of Mata sundri college were invoked. Some respondents described the online mode of learning as a boon, a silver lining in an unpredictable situation of a global pandemic. It not only helped in accessing education from home or remotely, but also saved time for co-activities as well, such as learning some soft skills through online courses. These in turn, as was reported, added to the respondents' academic credentials, and opened up scope for varied career opportunities. Online mode of learning also reduced transportation expenses for the respondents.

In contrast, another group of students experienced the completely opposite impact of e-learning in their lives. Online mode of learning impacted them very adversely as the respondents reported being prone to turn lethargic and reckless about their academic performance. At the same time, lack of discipline, time management and organization of study time contributed to their poor performance. Attending continuous classes for 4-5 hours without any break made them exhausted and annoyed sometimes. Many students felt bored due to online classes in which they saw nothing more than monologues from the teacher, lacking any face-to-face interaction, with either the teacher or fellow classmates. Lack of concentration and connection were experienced by many respondents. Technical glitches and poor internet connectivity at both ends- teachers as well as the students- further aggravated the above-mentioned problems. The respondents reported declining interaction between students and teachers, as well as, within the groups of students; the number of group discussions had also drastically reduced, which only contributed to lack of initiative, participation and performance among the respondents. Sitting in front of the laptop or mobile screen for long not only impacted human behavior but also caused back pain, strains in the eye and uneven posture. Impacts on respondents' mental health were also talked about, as they were completely confined to the

four walls of their houses with very minimal exposure to the outside world, contributing to nil social life and interaction.

The research intended to assess the changes in the participation of the students in online classrooms in terms of figures, the data disclosed that only 34 per cent of the respondents said that their performance had improved in online classes. On the other hand, 66 per cent believed that online education had led to a downfall in the active participation of the students as well as in their personal performances. 10 % of the respondents were of the view that online mode of learning has had negligible change in their class participation and academic performance. Respondents opined that switching to the new mode of learning via different e- learning methods such as Zoom app, Google classroom, Google meet, Youtube etcetera were new experiences for both teachers and students. But on the other hand, the respondents complained of facing challenges such as difficulty in understanding and using the apps for online education. The current modality proved to be of enormous difficulty for the respondents with disabilities as they found it more difficult to participate in online classrooms.

Education and academic performance of the students was affected the most with the sudden switch of learning mode from classroom to online mode. There has been a concept of distance learning and correspondence courses but neither of them involved online learning as a full-time mode of teaching for students. Only the add-on courses were adept with this technology. However, students and teachers both had to suddenly make a switch to online mode of learning as Covid- 19 did not give scope for classroom learning to continue. As this move was unprecedented, so were the impacts of it.

It took both students and teachers some time to adapt well with online mode of learning. However, a lot of students complained of worsening academic performance and their understanding of the subject in the online classes due to continuous interruptions, both physical and virtual, and the lack of humble classroom facilities like blackboard in the online classes made it difficult for them to understand certain things.

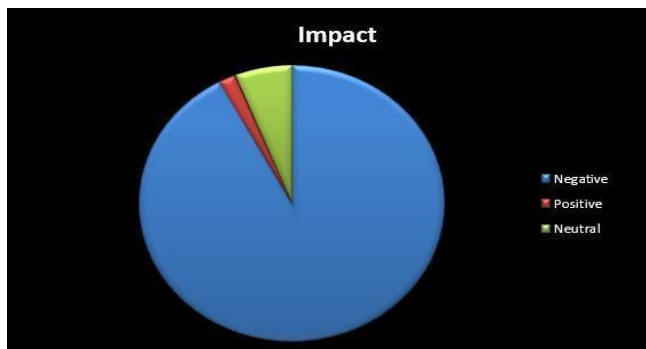
In our research we found that most of the students' claimed that their academic performance had worsened in the online mode of learning. There were a lot of students who believed that their academic performance in the online learning mode has remained the same as it was in the classroom mode. On the other hand, a handful of students stated that they had performed better in the online learning mode.

The data gathered through research, presented the following numbers:

Worsened: 51

Improved: 18

Same as earlier: 46



Neutral about the impacts: 7

negative impacts: 106

positive impacts: 2

Online mode of learning spared students from all the hustle of getting up early, catching metros and buses to reach the college on time. It gave students a lot of time to spend with themselves, which was usually spent travelling. In the beginning of the lockdown, a lot of people indulged in fitness and training as it became a raging trend on social media. People started taking care of their bodies in lockdown which they had stoically neglected for a long time.

However, with the starting of online classes, the duration given to self, started decreasing, and in fact, sitting continuously in the same position at the same place deteriorated the students' health and several of them started complaining about recurring backaches, headaches, negative impact on the eyes due to continuous exposure of blue rays, lethargy, obesity, tiredness and several other health issues.

In our research we found that though the students felt happy about saving their morning hours with the online mode of learning, they felt unhappy or rather dissatisfied with the hordes of physical health issues it tagged along with it. The respondents were given a choice between yes and no to answer the question if they had faced any physical health issues during this online mode of learning, and were asked to further explain what effects they could see. A lot of them answered in the negative and listed down the aforementioned health issues. One thing that a lot of them mentioned was that the breaks between two lectures and moving from one room to another within those breaks used to help them in straightening their bodies, as opposed to continuous sitting in front of mobile phones or computers.

However, there were two responses which mentioned that they could work constructively on their bodies in building their health in the duration that they usually spent traveling to the college.

The research aimed to unearth the prominent gains or losses, with respect to the respondents, in terms of change in education since the beginning of the online mode of learning. It was found

that most of the students remain dissatisfied in the present day due to the lack of overall classroom experience in the online learning apps. However, there were also a handful of people who believe that online classes have made them more comfortable and confident. Since the classroom learning came to a halt with no prior warning, online mode of learning emerged as an apt alternative to it. Though it took some time to make people comfortable with it and make them aware about its benefits, the transition period in between was a little painful for everyone, be it students or teachers. The transition period being the most difficult, maximum number of issues were observed in this period. Though the situation is not much better even now, it is moving gradually towards normalcy. Hopefully the online mode of learning would be embraced as much as the classroom learning in the near future. For now, there is still some dissatisfaction among students regarding online learning mode. Lot of them believe that it is not as effective as classroom learning as there is a lack of student-teacher interaction, student-student interaction and an overall lack of classroom atmosphere in online learning apps, which do not give students as much freedom as the classrooms to have discussions with each other and make interactions in other ways too.

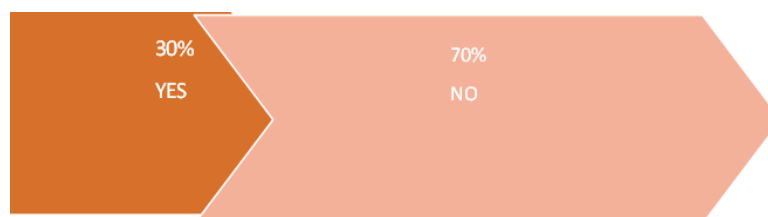
The data gathered through research

Less interaction with teacher and students: 54

Loss the enjoyment of classroom studies: 53

Feel more confident: 8

On a concluding note, the research asked the respondents whether they would like to continue with online mode of learning in post-pandemic times as well, to which the reply was:



## CONCLUSION

The research concludes that the students continued with their studies through the online mode voluntarily, but the process was not bereft of numerous pressures which impacted their lives in significant ways. Several factors influenced their experience, some of which students could control, while others, which were out of their hands. Students had to balance work and family,



manage time, and bring about massive changes in their personal time. The research concluded that in the absence of physical interaction, the respondents felt that the instructors/teachers should work to build a conducive classroom environment, and work to create a sense of community. The data suggested that it is the absence of physical correspondence between teachers and students that impacts the nature of interaction between them. The students often feel unconnected and develop indifference to what is being shared in the class. In some cases, students seemed to miss the physical markers and cues that made social connections easier to negotiate. Others seemed to thrive in the new environment. While some of the responsibility rests with the student, much rests with the instructor to create vibrant online experiences that allow for new intellectual skills to be developed and used. It is important to begin to uncover students' experiences with online learning because doing so can help to show effective online practices, student perceptions of online learning, and student satisfaction in the online environment. Our research depicted that most of the students preferred the traditional mode of education rather than the online mode. All of these can provide information about whether students will likely continue to accept online delivery of instruction and factors that will influence their persistence and retention in these courses. Throughout this research, the primary focus was to discuss how effective online mode of education is which served as the theoretical framework for this research. We examined various aspects of online education. We then examined which mode of education is most superior by students over time, and the impacts (psychological, physical) of online education. We can conclude our research on the basis that the most suitable mode of education for the respondents was traditional(offline) mode.

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## BEHAVIOURAL NUDGES IN THE ARENA OF MACROECONOMICS IN INDIA: MAKING A DIFFERENCE IN HEALTH AND EDUCATION

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### ABSTRACT

*Nudge theory in economics is Richard Thaler's Nobel Prize-winning insightful research along with Cass R Sunstein's Holberg prize. This entrenched the idea in social science. It is an interdisciplinary interphase bordering on social and psychological aspects of economics. Nudge theory does not harm the civil liberty of the people it is meant for, it gives them a choice to change for their own benefit and for the nation as a whole. Nudge in policies has been mostly successful in engineering the desired change.*

*Macroeconomics policy relies in ensuring the development and growth of the nation as a whole and has been silently relying on the Nudge or the soft push to align people with what the policy desires to achieve, the intended goals. Nudge theory has been used for generations, but it took Thaler in 2008 to look into it from the economics point of view and explain and bring it into the policy discussion table in the theoretical studies. This paper explores the Nudge theory used in the Indian economy in the political arena through the various policies rolled out. The Research Design here is to include India as the study area is based on secondary sources and is analyzed through charts and other statistical tools. This research paper will guide those who are interested in the functioning of Nudge in policy and planning in Indian economics.*

*Keywords: Interdisciplinary, Nudge, Macroeconomics, Economy, policy*

### INTRODUCTION

Behavioral economics uses Nudge, which is "to push something or someone gently" (Cambridge, 2022) for better outcomes. Richard H Thaler and Cass R Sunstein introduced the concept of Nudge Theory in 2008 by publishing the book 'Nudge- Improving Decisions about Health, Wealth, and Happiness.' According to them, Nudge Theory is a great way to gently push people towards certain behavioural changes which are important for them and the society as a whole, while giving them a free will (Thaler & Sunstein, 2008).

Nudge Theory focuses on indirect encouragement rather than enforcement. Forcing change can be extreme, confrontational, and can lead to resistance, whereas, Nudging changes can be less confrontational, relatively smooth, pleasurable, and manageable. It believes in the philosophy of the need to preserve an individual's free choice rather than forcing decisions on them. Nudging people

into proper behaviour for economic growth is one of the best ways to achieve the country's desired development goals. Policies designed to nudge people ultimately bring more benefits for the individual and the nation.

Due to the work of psychologists Daniel Kahneman, Amos Tversky, and American Academics Richard H Thaler and Cass R Sunstein Nudge, is now an application in behavioural economics (CBSB 2022, HLS 2022). Nudging people into implementing the policies and other macroeconomic activities which help in the economic growth led to the setting up of Nudge Units or Behavioural Insights teams in countries like Germany, Singapore, and Ireland.

India's policy-making has used Nudge with cautiousness. The economic survey (GOI, 2019), chapter titled "Policy for Homo Sapiens, Not Homo Economicus: Leveraging the Behavioural Economics of Nudge" provides the policy makers a behavioural reasoning platform for nudging people toward desirable behaviour. The Nudge theory uses the concepts of human psychology and how it can be used to change people's behaviour toward a desirable demeanour. National Institution for Transforming India (NITI) Aayog has a Nudge Unit or a Behavioural Insights team in India (Gaurav, 2019).

Macroeconomic scenario has been indulging in the policies of Nudge as they are rising in popularity. Therefore, this research paper explores the policies of nudge. NITI Aayog's Nudge Unit is explored and so are various policies that have and are being rolled out based on behavioural economics. Secondary data has been collected from research undertaken in social sciences with respect to India and through the policies being followed by the various ministries, NITI Aayog. Policies which have and are making a difference are explored through the "Nudge" lens. The study's focus is Health and Education aspects in policy and achievements since these two areas capture the crux of economic development of the nation.

Macroeconomics Nudges are becoming intrinsic to behavioural economics and policy-making in India. This research explores possible behavioural pathways are changes desired through policies. This research paper will guide those interested in the functioning of policy and planning Nudges in Indian Economics. The paper shows that nudges that softly push the homo economicus results into them behaving in a more human- homosapien way.

## REVIEW OF LITERATURE

Understanding that humans do not behave rationally, as certain biases cloud their judgment, behavioural economics understands it and gives in to the importance of human psychology. Nudging people between "Laissez faire" and "Incentives" pushes people gently towards desirable behaviour, successfully implementing the policies while giving the individual the freedom to opt for their choice (GOI, 2019). The drift in an individual's choice of what he does instead of what he should is due to the Cognitive biases (Cherry, 2020). Amos Tversky and Daniel Kahneman (1972) described the concept, which states the error in an individual's thinking during interpretation. Nudging can help people overcome these cognitive biases Sharma et al., (2017).

The concept of Nudging developed years before it was named. Psychologists try to find the reasons that explain an individual's behaviour and alter them. Maslow's Need of Hierarchy is such an example. Abraham Maslow, in his theory of Motivation, describes the five needs of humans which motivate human behaviour. The needs start from the lowest level, that is, physiological, and step up to the next level when an individual fulfils his needs. (Cherry, 2022). These needs nudge people to behave in a way to fulfil them.

Importance of Nudging people into implementing the policies and other macroeconomic activities which help in the economic growth led to the setting up of 'Nudge Units' or 'Behavioural Insights' teams in countries like Germany, Singapore, and Ireland. Following these steps towards development, NITI Aayog announced the setting up of a nudge unit in India (Gaurav, 2019).

Policy proposals and policies have ridden on behavioural economics. In the article 'Industrial Growth in the 1980's' Kelkar & Kumar (2019) emphasise the use of incentives for policy reforms through "the long-term fiscal policy needs to be modified so as to encourage savings by a further sharpening of incentives" and requirement of "an urgent reform of the export incentives structure so as to link imports of capital goods and intermediate inputs more strongly to actual export performance and export obligation and also 'providing free trade like regime to domestic manufacturers of capital goods and intermediate products to source their inputs either domestically or through imports in industries which are facing competitive pressure from imports in their competitive markets"

Leading people towards sustainable development is a joint work of intrinsic, extrinsic, and societal rules (Agarwal, 2020). The use of nudging in policies is a valuable tool, but several challenges also narrow its scope. The article "Policies Need a Cautious Nudge" (Gaurav, 2019) states the worries about the lawfulness of Nudge and argues that the basis of behavioural economics are the biased

judgment made by the people and questions how can people decide what is beneficial for themselves and thus nudge themselves into rationalization.

## OBJECTIVE OF STUDY

- This research paper tries to analyse the various policies in the Indian macroeconomic arena and provides the reasoning behind the policies of nudge.
- The study also tries to analyse the impact of such policies on Health and Education

## RESEARCH DESIGN

The study is based on the policy and planning at the macroeconomic level in India. The data is sourced as secondary data from the Government of India websites such as those of the various ministries, the economic survey and NITI Aayog. The data has been analysed statistically through tables and graphs. The study's focus is Health and Education aspects in policy and achievements.

## HYPOTHESIS

$H_1$  = Policies have been engineered with the aspect of 'Nudging' in India

$H_{01}$  = Policies have not been engineered with the aspect of 'Nudging' in India

$H_2$  = Nudging aspect in Indian macroeconomic policies has helped in achieving desired goals

$H_{02}$  = Nudging aspect in Indian macroeconomic policies has helped in achieving desired goals

## Analysing the Policies of Nudge in Economics

The macroeconomic policies for India which are trying to use behavioural economics for the benefit the people and of the nation are analysed under the following

- Health and Nutrition and the macroeconomic policies that use nudging
- Education and the macroeconomic policies that use nudging

The tables below present the impact of nudging and it also presents analysis of the usage of nudging with regard to the achievement

Table 1: Health and Nutrition and the macroeconomic policies that use nudging

Year	Policy	Aim	Nudges
1995	Mid-Day Meal	Eliminate hunger during the education	Nudges students to eat healthy and nourishing food
2014	Swatchh Bharat Mission	Focus on Sanitation	Attracts citizens to schools and other areas with cleanliness and toilets and gives a positive push
2015	Pradhan Mantri Jeevan Beema Yojna	Increase in the coverage of insurance amongst the citizens	Nudging people towards taking health insurance
2018	Ayushman Bharat Programme	Coverage for each family upto 5 lakh per year	A slight push for the people who are below poverty line to get proper treatment

Author's own (reference:Yojna, 2016; Ministry of Jal Shakti, 2022; MoF, 2022 & NHPM, 2018)

Here it is nudge that is inbuilt in the policies regarding Health and Nutrition, thus the nudges are an important part of the working of these policies. An opportunity for people to choose healthy meals, thus attracting students as well as health insurance and free treatment for the ones below poverty line.

Table 2: Education and the macroeconomic policies that use nudging

Year	Policy	Aim	Nudges
1995	Mid-Day Meal	Increase in the enrolment and attendance of the students	Nudging students to attend classes by offering them nourishing meals on a daily basis
2009	Rashtriya Madhyamik Shiksha Abhiyan	Improving the quality and accessibility to secondary education	Quality attracts students
2015	Sukanya Samriddhi Yojna	Saving funds for girl child education or marriage	Nudging for reducing gender bias with higher studies fund and savings
2015	Beti Bacho Beti Padhao	Gender ratio and women education	Nudging for increasing girl child ratio and school enrolment

Author's own (reference:Yojna, 2016; NIC, 2021; NSI, 2022; BBBP, 2019)

Analysis of the impact of the macroeconomic policies through Health and Education Index in the larger states of India has been undertaken. The data makes it clear that nudging has had a positive impact but the change has been slow. This could be due to the fact that nudging itself leaves the choice to the consumer to take the benefit the way they seem fit. Education for all and a special focus on the girl child's education could push the nation towards a higher level of development achievement.



Table 3: Analysing Health and Education Index

States of India	Health Index 2018-2019	Health Index 2019-2020	Education Index 2015-2016	Education Index 2016-2017
Kerala	81.60	82.20	77.64	82.17
Tamil Nadu	70.79	72.42	63.16	73.35
Haryana	49.81	49.26	51.04	69.54
Maharashtra	65.54	69.14	58.64	62.55
Rajasthan	41.57	41.33	51.25	59.43
Punjab	56.33	58.08	50.74	59.06
Uttar Pradesh	25.06	30.57	32.81	46.45
Bihar	30.24	31.00	30	37.3
Madhya Pradesh	33.37	36.72	44.42	47.24
Andhra Pradesh	68.88	69.95	48.42	56.08

Table is authors own (data source: NITI 2016, 2017a, 2017b, 2019 & 2020)

There are some slow-moving states and some high moving states in terms of Health Index and Education Index. States of Kerala and Tamil Nadu are leading states while Uttar Pradesh and Bihar and Madhya Pradesh have much to achieve in terms of these indices.

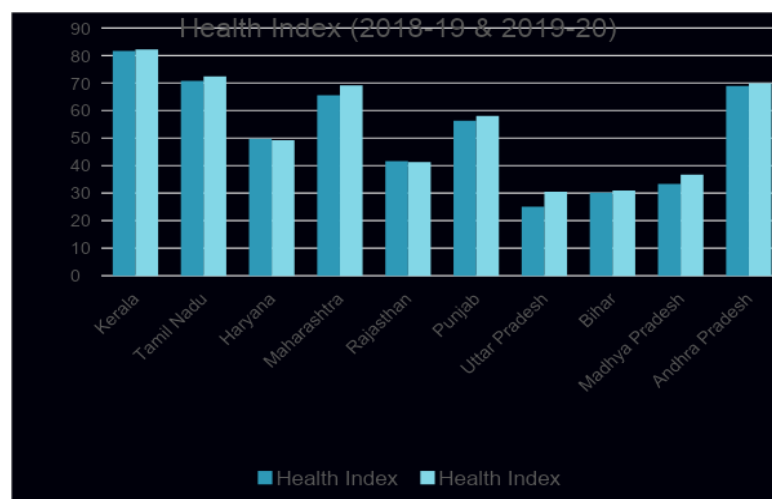


Chart 1: Health Index for larger states for 2018-19 and 2019-20

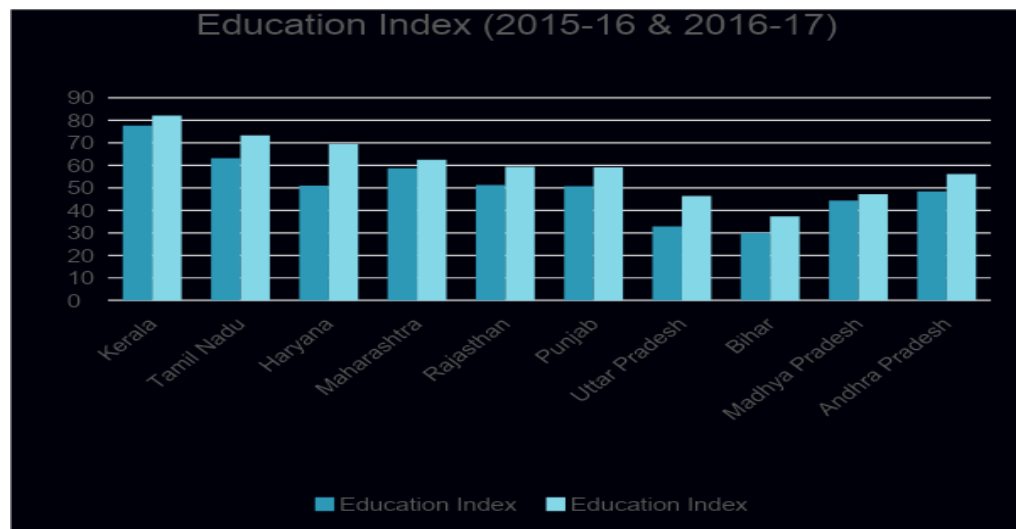


Chart 2: Education Index for larger states for 2015-16 and 2016-17

In terms of health and Education Index all the larger states of India shown here have progressed, this itself is an achievement as the states are making the scenario better for the people concerned and rising on the development scale. The charts show a steady change in the various states; some have been achievers but the ones who are lagging behind because of many macroeconomic factors are also working hard through the policies of nudge to improve their standing.

## CONCLUSION AND RECOMMENDATION

Nudges in various forms in policies have made a change globally and in India. Macroeconomics has used nudging in various spheres including health and education, the two basic and very important criterions of development for any economy. The term Nudging in Behavioural Economics raised itself on to a platform much later but the usage of nudging in policies subtle form did exist.

In India the path of behavioural economics is being lighted by the government through the Economic Survey (GOI, 2019) thus successfully introducing the concept of "Nudge" in relation to the public policies and shows the successful outcomes of Nudging in policies like "Beti Bacho Beti Padhao, Swachh Bharat Mission, and Give it Up." Thus, nudging can be put to use in various ways as there are different types of nudging as explained by Thaler and Sunstein in their book 'Nudge the final edition'. These can be further explored to find out which would work for which of the Indian states

better and they should accordingly be incorporated into the system of macroeconomic policy making. These should be protected so that on the basis of visible changes the policies should be reformulated.

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## Special Types of Matrices and Their Applications

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### Abstract

*Matrix theory is an important field of study with wide scope of research. The applications of matrices range from scientific domains to real life problems, being used either directly or through numerical and geometric analysis. This survey article presents an overview about some of the special types of matrices, their properties and real-life applications.*

### Keywords

Matrices, Determinants, Matrix operations.

### 1. Introduction

The term matrix was first introduced by James Joseph Sylvester in 19<sup>th</sup> century followed by the algebraic aspects of matrices presented by Arthur Cayley (Cayley, 1858) which gave a boost to matrix theory and developed into a recognized and interesting field of research. Over the years, with the evolution of the concept, matrices have seen an extended use in research, commerce, social science and are being used in computer graphics, optics, cryptography, economics, chemistry, geology, robotics and animation, wireless communication and signal processing and finance.

Matrices have a long history of use in solving linear equations, dating back to 300BC. Nine Chapters of the Mathematical Art (Yong and Suanshu, 1994), a key Chinese literature, presents a method to solve simultaneous linear equations along with an idea of determinant and rectangular arrays. Dating from 300 BC to 200 AD, the literature contains the first documented example of the use of matrices to solve simultaneous linear equations. The method to solve simultaneous linear equations was introduced to Europe by the Italian mathematician Gerolamo with the publication of Ars Magna (Cardano and Spon, 1965) in 1545. The determinant which was introduced by the Japanese mathematician Seki Takakazu in 1683 first appeared in Chinese literature over 2,000 years ago. Chapter 8 viz., Methods of rectangular arrays, shows matrix-like number arrangements along with a method for solving simultaneous equations using a counting board which is mathematically identical to Carl Friedrich Gauss's modern matrix method (Jamil, 2012) of solution.

The Method of Solving Dissimulated Problems, published in 1683, by Seki Takakazu established a generic method for determining the determinant of a matrix and using it to solve

equations. In his work *Elements of Curves*, published in 1659, Dutch mathematician Jan de Witt used arrays to depict transformations. In the first decade of 18<sup>th</sup> century, Gottfried Wilhelm Leibniz popularized the use of arrays for storing information or solving problems. In 1750, Cramer introduced Cramer's rule which provides generic formula defined as determinants for any unknown in a linear equation system. At the turn of the nineteenth century, Gauss proposed a strategy for solving a system of linear equations without introducing the concept of matrices which is now known as Gauss Elimination method (Jamil, 2012; Dopico, 2012). However, it was in 1850 that the term matrix was introduced and the matrix theory developed a strong base in mathematics. In 1850, James Joseph Sylvester used the term matrix, which comes from the Latin word womb, to describe a collection of numbers. Sylvester (1851) defined a matrix as a rectangular array of terms, out of which different systems of determinants may be engendered, as from the womb of a common parent; these cognate determinants being by no means isolated in their relations to one another, but subject to certain simple laws of mutual dependence and simultaneous deperition. In simple terms, a matrix is a rectangular array which includes numbers, symbols, or expressions, arranged in rows and columns. Each cell in the matrix is called an element or an entry.

The use of arrays in early matrix theory was almost solely limited to determinants and Cayley's abstract matrix operations were groundbreaking. Matrix multiplication and matrix algebra is a result of Arthur Cayley's work. Two papers, one in 1850 and the other in 1858 published Cayley's work which includes the inverse of the matrix, rules for matrix compounding which is same as matrix multiplication and some more properties of matrices. He was a pioneer in the development of a matrix notion that was independent of equation systems. Cayley devised and demonstrated the well-known Cayley–Hamilton theorem in his memoir on the theory of matrices published in 1858, which states that every square matrix satisfies its own characteristic equation.

Matrix theory emerged as an important mathematical theory due to the work of female mathematician Olga Taussky Todd (1977) popularly known as the mother of matrix theory, who used matrices to investigate vibrations on airplanes during World War II. She developed several concepts viz., number theoretical integral matrices, integral matrices connected with number theory, etc. The modern bracket notation of matrices was introduced by Cuthbert Edmund Cullis in 1913. He was the first one to illustrate the use of  $A = a_{i,j}$  to represent a matrix where  $a_{i,j}$  refers to the element in the  $i$ th row and the  $j$ th column. In 1955, Leonid Mirsky's text, *An Introduction to Linear Algebra* played a significant role in making matrix theory as one of the most important areas of research.

Matrices have a wide range of applications in science and have been applied to solve real-world problems. Matrices are used to represent real-world data, message encryption and decryption, cryptography, coding theory, creating 3-D images and 2-D motion, to compress electronic data and to store fingerprint data, robotics and automation, CT scans and MRI scans, in economics to calculate gross domestic products, wireless application protocol, profit prediction, UV spectroscopy, automobiles, etc. The matrices are used in physics while applying Kirchhoff's Laws of Voltage and Current to solve problems, to explore electrical circuits, quantum

mechanics and optics, to create graphs, calculate statistics, and conduct scientific research in a variety of domains.

In this paper, section 2 presents 5 special types of matrices viz., Hadamard matrix, Sparse matrix, Idempotent matrix, Vandermonde matrix and Pascal matrix. In section 3 we discuss Rhotrix and its properties. Section 4 concludes the paper.

## 2. Special Types of Matrices

In this section, we study about few of the special types of matrices, their properties and applications. Our focus in this survey will be on Hadamard matrix, Sparse matrix, Idempotent matrix, Vandermonde matrix and Pascal matrix.

### 2.1. Hadamard Matrix

Hadamard matrix (Hedayat and Wallis, 1978) is defined as follows:

Definition 2.1.1 : Hadamard matrix is a square matrix of order  $n$  with entries either +1 or -1 whose rows and columns are pairwise orthogonal.

For example:  $H_1 = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix}$  is a Hadamard matrix.

It is worth noting that every matrix with entries +1 and -1 may not be Hadamard matrix.

For example:  $H_2 = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix}$  is not a Hadamard matrix.

The matrix  $H_2$  has entries +1 and -1 but the rows and columns are not mutually orthogonal. The third row does not give dot product as zero with any other rows, and hence is not orthogonal to them. Similarly, the second column does not give dot product as zero with any other columns and is also not orthogonal.

A condition for an  $n \times n$  Hadamard matrix to exist is that  $n$  must be 1, 2 or a multiple of 4. In 1867, Sylvester constructed Hadamard matrix of order 1, 2, 4, 8, 16, 32, etc. and later on matrices of order 12 and 20 were constructed by Hadamard in 1893. Hadamard matrix is named so as the determinant of the matrix satisfies equality in the Hadamard's determinant theorem. Sylvester formed a Hadamard matrix of order  $2^k$  for all non-negative integer  $k$  as follows:



$$H_2^k = \begin{bmatrix} H_{2^{(k-1)}} & H_{2^{(k-1)}} \\ H_{2^{(k-1)}} & -H_{2^{(k-1)}} \end{bmatrix}$$

which is known as Sylvester-Hadamard matrix. Another construction of Hadamard matrix is Paley construction which was given by Raymond Paley in 1933. Earlier, the combination of Sylvester's and Paley's method did not produce matrix of order 92. Baumert, Golomb, and Hall constructed a matrix of order 92 using a computer in 1962. In 2005, a Hadamard matrix of order 428 was discovered for the first time by Hadi Kharaghani and Behruz Tayfeh-Rezaie [34]. As of 2014, there is no Hadamard matrix known for 668, 716, 892, 1132, 1244, 1388, 1436, 1676, 1772, 1916, 1948, and 1964 which are 12 multiples of 4 less than or equal to 2000.

In a Hadamard matrix,  $HH^T = nI$  where  $H^T$  is the transpose of  $H$ , and  $I$  is the identity matrix. This implies  $H$  is non-singular and has inverse  $n^{-1}H^T$ . Hadamard matrix satisfies Hadamard's determinant inequality which states that if  $A = a_{ij}$  is a matrix of order  $n$  where  $|a_{ij}| \leq 1$  for all  $i$  and  $j$ , then  $|\det A| \leq n^{n/2}$ . In a Hadamard matrix, if any row or column is multiplied by -1, then the matrix remains Hadamard matrix.

A Hadamard matrix is called a Skew Hadamard matrix if  $H + H^T = 2I$ . Just like Hadamard matrix, Skew Hadamard matrix exists for every  $n$  divisible by 4. As of 2006, it was known that Skew Hadamard matrix exist for all  $n < 188$  with  $n$  divisible by 4.

Hadamard matrix is used to retrieve data from communication systems, digital signal systems and image encoding in the presence of disturbances which rely on statistical approaches. Sylvester Hadamard matrices are used in a variety of fields including statistics, numerical analysis, coding theory, and cryptography. In 1951, the satellite Plotkin18 was the first to demonstrate the ability of codes derived from Hadamard matrices to repair errors. This was further investigated by Bose and Shrikhande in 1959, who established a link between Hadamard matrices and block code designs, and then developed by Harmuth in 1960 (Seberry et.al., 2005). Levenshtein was the first who constructed an algorithm for Hadamard Error Correcting Code. The Hadamard codes are simple to decode, and they are the first significant class of codes to repair multiple errors. A famous application of Hadamard Error Correcting Code was in the NASA space mission when the Mariner and Voyager space probes explored Mars and the outer planets of the solar system from 1969 to 1976 and they utilised a Hadamard code to encode data.

## 2.2. Sparse Matrix

A sparse matrix or sparse array is a matrix with most of its components as zero. The sparsity of a matrix is calculated by dividing the number of zero-valued elements by the total number of elements. A sparse matrix (Schneider and Taussky, 1977) is defined as follows:

Definition 2.2.1 : A matrix in which most of its elements are zero is called a sparse

matrix. For example:  $\begin{bmatrix} 0 & 0 & 4 & 0 & 8 \\ 0 & 0 & 2 & 3 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 9 & 5 & 0 & 0 \end{bmatrix}$  is a sparse matrix.

In order to use resources effectively, we only store non-zero elements instead of storing zero's with them. Triplets (Row, Column, value) are used to store non-zero elements. There are two types of sparse matrix representations viz., array representation and linked list representation. In an Array representation, only non-zero values, as well as their row and column index values are considered in formulation. The total number of rows, total number of columns, and total number of non-zero values in the sparse matrix are all stored in the 0th row in this representation. For example,

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 7 & 0 \\ 0 & 6 & 0 & 0 & 0 & 0 \\ 3 & 0 & 0 & 4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 8 \\ 0 & 0 & 5 & 0 & 0 & 0 \end{bmatrix} \rightarrow$$

Rows	Columns	Values
5	6	6
0	4	7
1	1	6
2	0	3
2	3	4
3	5	8
4	2	5

Figure 1: A 5 x 6 matrix

A linked list data structure is used to represent a sparse matrix in linked representation. We employ two different nodes in this linked list: the header node and the element node (Figure 2). Three fields make up the header node, while five fields make up the element node.

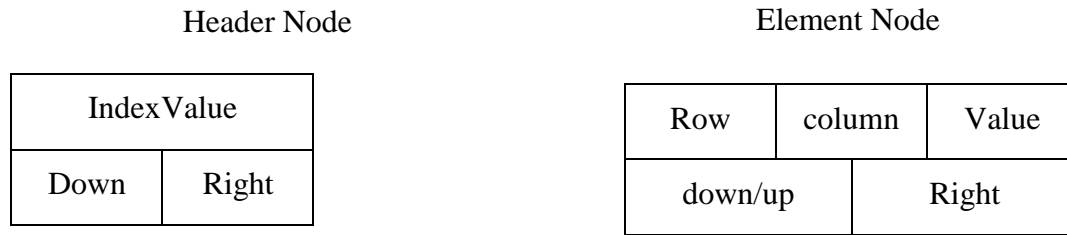


Figure 2: Header node and element node in linked list

$H_0, H_1, \dots, H_n$  are the header nodes that are used to represent indices, where  $n$  is the number of rows of the matrix. Except for the first node, which is used to convey abstract information of the sparse matrix, the remaining nodes are utilised to represent non-zero items in the matrix.

We use Sparse matrix rather than a simple matrix because there are fewer non-zero elements than zeros and as a result less memory is utilised to store only elements. By rationally creating a data structure that only traverses non-zero components, computing time can be decreased.

In combinatorics and applications such as network theory and numerical analysis, where crucial data or connections are frequently sparse, the concept of sparsity is useful. When solving partial differential equations, large sparse matrices are frequently used in scientific and engineering applications. Sparse matrices are common in machine learning, hence specialised computers have been created for them. Sparse matrices can be found in data preparation encoding techniques, structural engineering, reservoir simulation, electrical networks and in optimizing problems.

### 2.3. Idempotent Matrix

In 1870, Benjamin Peirce introduced the term idempotent. An idempotent matrix is defined as follows:

Definition 2.3.1 : A matrix  $A$  is idempotent if and only if  $A^2 = A$ .

For example:  $\begin{bmatrix} 3 & -6 \\ 1 & -2 \end{bmatrix}$  and  $\begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$  are idempotent matrices.

Since for an idempotent matrix  $A$ ,  $A^2 = A$ , therefore  $A$  must be a square matrix. Idempotent matrices are also known as periodic matrices or  $n$ -potent matrices (i.e.,  $A^n = A$ ). In particular, if  $n=3$ ,  $A$  is referred to as a tripotent matrix, and if  $n=4$  it is referred to as a quadri-potent matrix. For a  $2 \times 2$  idempotent matrix either the matrix is diagonal or has a trace equal to 1. Every idempotent matrix is singular except the identity matrix. If an idempotent matrix is subtracted from an identity matrix of same order, then the resultant matrix is also an idempotent matrix. A non-identity matrix is idempotent if the number of independent rows (and columns) is less than the number of rows in the matrix (and columns).

R.E.Hartwig and M.S.Putcha (1990) identified a set of criteria under which a matrix can be expressed as a sum of idempotent matrices or as a difference of two idempotent matrices. Any complex matrix  $T$  is a sum of finitely many idempotent matrices, as demonstrated by Pei Yuan Wu (1990), if and only if  $\text{trace } T$  is an integer and  $\text{tr } T \geq \text{rank } T$ . J.K.Baksalary and O.M.Baksalary

(2000) found a complete solution to the problem of describing all cases in which linear combinations of two different idempotent matrices  $P_1$  and  $P_2$  are also idempotent matrices. Every tripotent matrix  $B$  can be decomposed in a unique way as  $B = B_1 - B_2$ , where  $B_1$  and  $B_2$  are idempotent matrices such that  $B_1 B_2 = B_2 B_1 = 0$ .

Idempotent matrix is useful in functional analysis, particularly in the spectrum theory of transformations and projections. They are often used in regression analysis, econometrics and the theory of linear statistical models.

## 2.4. Vandermonde Matrix

Vandermonde matrix is a special type of matrix in linear algebra named after the French mathematician Alexandre-Théophile Vandermonde. Vandermonde did not discuss the concept of a Vandermonde matrix but gave the underlying principle of Vandermonde determinant or specifically, a method to solve linear equations in (Vandermonde, 1776) which was further shaped and presented by Sylvester (1850, 1851) and Cayley (Rawashdeh, 2019) after a century. A Vandermonde matrix (Strang, 2016) is defined as follows:

Definition 2.4.1 : Vandermonde matrix is a simple  $m \times n$  matrix with entries of the rows or columns as geometric progressions. It is of the form,

$$V_{mn}(x_n) = \begin{bmatrix} 1 & x_1 & x_1^2 & \cdots & x_1^{m-1} \\ 1 & x_2 & x_2^2 & \cdots & x_2^{m-1} \\ 1 & x_3 & x_3^2 & \cdots & x_3^{m-1} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & x_n & \cdots & \cdots & x_n^{m-1} \end{bmatrix}$$

and can be written as  $V_{ij} = x_i^{j-1}$ ,  $\forall i$  and  $j$ , where  $x_i$ 's are called nodes or points.

For example:  $V_1 = \begin{bmatrix} 1 & 1 & 1^2 & 1^3 \\ 1 & 2 & 2^2 & 2^3 \\ 1 & 3 & 3^2 & 3^3 \\ 1 & 4 & 4^2 & 4^3 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 4 & 8 \\ 1 & 3 & 9 & 27 \\ 1 & 4 & 16 & 64 \end{bmatrix}$  is a Vandermonde matrix.

Vandermonde determinant or Vandermonde polynomial (or Vandermondian) (Muir, 1906; Vandermonde, 1776) is the determinant of a square Vandermonde matrix ( $n=m$ ) which is the product of all differences of the values that define the elements and is given by,

$$v_n(x_1, \dots, x_n) = \det(V_n(x_1, \dots, x_n)) = \det(V) = \prod_{1 \leq i < j \leq n} (x_j - x_i).$$

Over the period of time, various proofs for the Vandermonde determinant were given using combinatorics or using induction along with elementary row or column operations (Mirsky, 1955; Knuth, 1997) or graph based techniques (Gessel, 1979). The determinant is non-singular or non-zero if and only if  $x_i \neq x_j, \forall i \text{ and } j$ , i.e., all  $x_i$ 's should be distinct and thus the square Vandermonde matrix is invertible where inverse is given by (Soto-Eguibar, and Moya-Cessa, , 2011)

$$(V_n^{-1})_{ij} = \frac{(-1)^{j-1} \sigma_{n-j,i}}{\prod_{\substack{k=1 \\ k \neq i}}^n (x_k - x_i)}$$

$$\text{where, } \sigma_{j,i} = \sum_{1 \leq m_1 < m_2 < \dots < m_j \leq n} \prod_{k=1}^j x_{m_k} (1 - \delta_{m_k,i}) \text{ and, } \delta_{a,b} = \begin{cases} 1, & a = b \\ 0, & a \neq b \end{cases}.$$

Different researchers have given different methods of calculating the inverse of a Vandermonde matrix. Yiu (2014) showed inverse as a product of two matrices, one of them being a lower triangular matrix using the partial fraction based technique, and F. Soto and H. Moya

(2011) showed inverse as a product of diagonal, upper triangular and lower triangular matrices. According to L. Richard (1966), inverse of the matrix is written as a product of simpler matrices, namely, upper triangular and lower triangular matrix.

If  $A^{-1}$  represents inverse of a Vandermonde matrix, then it can be written as:  $A^{-1} = U^{-1} L^{-1}$ , where,  $U$  is an upper triangular matrix and  $L$  is a lower triangular matrix.

$$U^{-1} = \begin{bmatrix} 1 & -x_1 & x_1 x_2 & -x_1 x_2 x_3 & \dots \\ 0 & 1 & -(x_1 + x_2) & x_1 x_2 + x_2 x_3 + x_3 x_1 & \dots \\ 0 & 0 & 1 & -(x_1 + x_2 + x_3) & \dots \\ 0 & 0 & 0 & 1 & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix} \text{ and,}$$

$$L^{-1} = \begin{bmatrix} \frac{1}{x_1-x_2} & \frac{0}{x_2-x_1} & \frac{0}{x_3-x_1} & \cdots \\ \frac{1}{(x_1-x_2)(x_1-x_3)} & \frac{1}{(x_2-x_1)(x_2-x_3)} & \frac{1}{(x_3-x_1)(x_3-x_2)} & \cdots \\ \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots \end{bmatrix}.$$

Many attempts at generalizing the Vandermonde matrix have been made which is of the form:

$$G_{mn}(x_n) = [x_j^{\alpha_i}]_{i,j}^{m,n} = \begin{bmatrix} x_1^{\alpha_1} & x_1^{\alpha_2} & \cdots & x_1^{\alpha_m} \\ x_2^{\alpha_1} & x_2^{\alpha_2} & \cdots & x_2^{\alpha_m} \\ x_3^{\alpha_1} & x_3^{\alpha_2} & \cdots & x_3^{\alpha_m} \\ \vdots & \vdots & \ddots & \vdots \\ x_n^{\alpha_1} & \cdots & \cdots & x_n^{\alpha_m} \end{bmatrix}$$

where  $x_i \in \mathbb{C}$ ,  $\alpha_i \in \mathbb{C}$ ,  $i = 1, 2, \dots, n$ . One such generalization is the Alternant matrix (Strang, 2016) which is obtained by replacing the geometric progressions by functions. It is represented as,

$$A_{mn}(f_m; x_n) = [f_i(x_j)]_{i,j}^{m,n} = \begin{bmatrix} f_1(x_1) & f_1(x_2) & f_1(x_3) & \cdots & f_1(x_n) \\ f_2(x_1) & f_2(x_2) & f_2(x_3) & \cdots & f_2(x_n) \\ f_3(x_1) & f_3(x_2) & f_3(x_3) & \cdots & f_3(x_n) \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ f_m(x_1) & f_m(x_2) & \cdots & \cdots & f_m(x_n) \end{bmatrix},$$

where  $f_1, f_2, \dots, f_m$  are functions from a field  $F \rightarrow F$ .

Karl Lundengård (Strang, 2016) mentioned some of the varied applications of the Vandermonde matrix ranging from polynomial interpolation, optimal experiment design, least square regression, error-detecting and error-correcting codes construction, to calculation of the discrete Fourier and related transforms, solving systems of differential equations with constant coefficients, various problems in mathematical, nuclear, and quantum physics and describing properties of the Fisher information matrix of stationary stochastic processes. One of the simplest method used to find the interpolating polynomial is using the Vandermonde matrix, which under generalized conditions can also be seen for interpolation of non-polynomial functions or points in more than two dimensions. Vandermonde matrix can also be used to prove the unisolvence theorem.

### 3. Rhotrix

In this section we discuss rhotrices which is similar to matrices yet has a different structure. In 2002, Ajibade (2002) introduced rhotrix as an extension to the mathematical arrays which are somewhat in between two-dimensional vectors and  $2 \times 2$  dimensional matrices, an extension to the idea of matrix-tertions and noitrets and forms a group in itself. The arrangement of entries of the rhotrix is rhomboidal. Study of rhotrix theory has two approaches: commutative ring theory and non-commutative ring theory. The commutative ring theory uses the heart based multiplication method as proposed by Ajibade (2002). This method is based on the analysis and initial algebra of rhotrices. The non-commutative ring theory uses a row-column based method for rhotrix multiplication as proposed by Sani (2004).

Definition 3.1 : A rhotrix is defined as follows:

$$A = R(3) = \left\{ \left\langle \begin{array}{ccc} & a & \\ b & h(A) = c & d \\ & e & \end{array} \right\rangle : a, b, c, d, e \in \mathbb{R} \right\} \quad (1)$$

It consists of mainly 3 parts - heart, major and minor entries. Here,  $h(A) = c$  is called the heart of the rhotrix  $A$  defined as the element at the perpendicular intersection of the two diagonals of a rhotrix.

According to Ajibade (2002) if we consider  $A$  and  $B$  to be two three-dimensional rhotrices, then addition (+), scalar multiplication and multiplication ( $\circ$ ) of these rhotrices is defined as:

$$A = \left\{ \left\langle \begin{array}{ccc} & a_1 & \\ b_1 & h(A) = c_1 & d_1 \\ & e_1 & \end{array} \right\rangle : a_1, b_1, c_1, d_1, e_1 \in \mathbb{R} \right\} \quad \text{and}$$

$$B = \left\{ \left\langle \begin{array}{ccc} & a_2 & \\ b_2 & h(B) = c_2 & d_2 \\ & e_2 & \end{array} \right\rangle : a_2, b_2, c_2, d_2, e_2 \in \mathbb{R} \right\} \quad (2)$$

$$A + B = \left\langle \begin{array}{ccc} & a_1 + a_2 & \\ b_1 + b_2 & h(A) + h(B) & d_1 + d_2 \\ & e_1 + e_2 & \end{array} \right\rangle. \quad (3)$$



$$\text{For any scalar } \alpha \in \mathbb{R}: \alpha A = \begin{pmatrix} \alpha a_1 & & \\ \alpha b_1 & \alpha h(A) & \alpha d_1 \\ & \alpha e_1 & \end{pmatrix}$$

$$A \circ B = \begin{pmatrix} a_1 h(B) + a_2 h(A) & & \\ b_1 h(B) + b_2 h(A) & h(A)h(B) & d_1 h(B) + d_2 h(A) \\ & e_1 h(B) + e_2 h(A) & \end{pmatrix}.$$

This method of rhotrix multiplication is referred to as Ajibade's heart based method for multiplication of rhotrices. A similar row-column based method for rhotrix multiplication was given by Sani [36] as,

$$A \circ B = \begin{pmatrix} a_1 a_2 + d_1 b_2 & & \\ b_1 a_2 + e_1 b_2 & h(A)h(B) & a_1 d_2 + d_1 e_2 \\ & b_1 d_2 + e_1 e_2 & \end{pmatrix}.$$

The definition given by Ajibade was further extended to an n-dimensional rhotrix by Mohammed in [44]. A rhotrix of size  $n$  is given as:

$$A(n) = R(n) = \left\{ \begin{pmatrix} & & a_1 & & \\ & a_2 & a_3 & a_4 & \\ \dots & \dots & \dots & \dots & \dots \\ a_{\{\frac{t+1}{2}\}-n/2} & \dots & \dots & h(A) = a_{\{\frac{t+1}{2}\}} & \dots & \dots & a_{\{\frac{t+1}{2}\}+n/2} \\ \dots & \dots & \dots & \dots & \dots & \dots & \\ & a_{t-3} & a_{t-2} & a_{t-1} & & & \\ & & a_t & & & & \end{pmatrix} : a_1, a_2, \dots, a_t \in \mathbb{R} \right\} \quad (4)$$

where  $n \in 2\mathbb{Z}^+ + 1$ ,  $t = \frac{1}{2}(n^2 + 1)$  and  $h(A) = a_{\{\frac{t+1}{2}\}}$  is the heart of the rhotrix matrix in  $R(n)$ .

There are two types of rhotrices: an even dimensional rhotrix and an odd dimensional rhotrix. An odd dimensional rhotrix is simply a rhotrix having odd dimensions, for eg. the simplest odd dimensional rhotrix is a 3-dimensional rhotrix we mentioned earlier (1). An even-dimensional rhotrix is a rhotrix having even dimensions. Simplest even dimensional rhotrix is defined as follows:

$$R(2) = \left\{ \begin{pmatrix} & a & \\ b & & d \\ & e & \end{pmatrix} : a, b, d, e \in \mathbb{R} \right\}.$$

This is known as a real rhotrix of dimension two, also known as heartless rhotrix (*hl*-rhotrix). A.O. Iser (2018) gave the cardinality of an even-dimensional rhotrix as the  $|R(n)| = \frac{1}{2}(n^2 + 2n)$ , where  $n \in 2\mathbb{N}$ . Addition and multiplication for even dimensional and odd dimensional rhotrices are the same.

Mohammed (2007) defined rhotrix exponent rule for any integer  $m$  as,

$$R^m = (h(R))^{m-1} = \begin{pmatrix} ma & & \\ mb & h(R) & md \\ & me & \end{pmatrix}.$$

If  $m = 0$ , then the identity of rhotrix is defined as:

$$\mathbf{I} = R^0 = \begin{pmatrix} & 0 & \\ 0 & 1 & 0 \\ & 0 & \end{pmatrix} \quad (5)$$

and if  $m = -1$ , then the inverse of a rhotrix is given by:

$$R^{-1} = \frac{-1}{(h(R))^2} \begin{pmatrix} & a & \\ b & -h(R) & d \\ & e & \end{pmatrix}. \quad (6)$$

For a rhotrix  $R$  with the defined rhotrix addition (4),  $\langle R, + \rangle$  forms a commutative group with identity element and inverse defined as given by (5) and (6), respectively. A rhotrix  $A$  is said to be invertible if  $h(A) \neq 0$ , and if  $h(A) = 0$  and  $A \neq 0$  then  $A^2 = 0$ .

Similarly, Identity *hl*-rhotrix is defined as:

$$\mathbf{I} = \begin{pmatrix} & 1 & \\ 0 & & 0 \\ & 1 & \end{pmatrix}$$

and inverse of a *hl*-rhotrix is defined as:

$$R^{-1} = \frac{1}{ae-bd} \begin{pmatrix} & e & \\ -b & & -d \\ & a & \end{pmatrix}, \text{ where } ae \neq bd.$$

Along with an  $n$ -dimensional rhotrix as (4), Mohammed (2007) also defined an  $n$ -dimensional rhotrix as follows:

$$R(n) = \left( \begin{array}{cccccc} & & & a_{11} & & \\ & & a_{21} & c_{11} & a_{12} & \\ a_{t1} & \dots & \dots & \dots & \dots & \dots \\ & \dots & \dots & \dots & \dots & \dots \\ & & \dots & \dots & \dots & a_{tt} \\ & & & a_{tt-1} & c_{t-1t-1} & a_{t-1t} \\ & & & & a_{tt} & \end{array} \right)$$

where  $a_{ij}(i, j = 1, 2, \dots, t)$  are called the major entries and  $c_{kl}(k, l = 1, 2, \dots, t-1)$  are called the minor entries of  $R$ . A  $n$ -dimensional rhotrix  $R(n) = \langle a_{ij}, c_{kl} \rangle$  is called as a couple of two matrices namely  $(a_{ij})$  called the major matrix and  $(c_{kl})$  called the minor matrix. A Hilbert rhotrix of size 5 was formed using a Hilbert matrix of size  $3 \times 3$  and of size  $2 \times 2$  using this concept. We can also define rank of a rhotrix  $R(n) = \langle a_{ij}, c_{kl} \rangle$ , where  $a_{rr}(1 \leq r \leq t)$  and  $c_{ss}(1 \leq s \leq t-1)$  as,  $\text{rank}(R) = \text{rank}(a_{ij}) + \text{rank}(c_{kl})$ , where properties of rank of matrix can be extended to rank of rhotrix.

Rhotrix theory has applications in algebra. Using the exponent rule and the properties of rhotrices [43,42], the algebraic series and expansion can be expressed in terms of rhotrices. If we consider the rhotrices  $A$  and  $B$  (2), the arithmetic series in terms of rhotrices is given by:

$$S_n = \sum_{k=1}^n [A + (n-1)B]$$

where  $S_n$  is the arithmetic progression with  $A$  as the first term and  $B$  as the common difference. The  $n^{th}$  sum is given as:

$$S_n = \frac{n}{2} \{2A + (n-1)B\} = \frac{n}{2} \left\{ 2 \left( \begin{array}{ccc} a_1 & & \\ b_1 & h(A) & d_1 \\ & e_1 & \end{array} \right) + (n-1) \left( \begin{array}{ccc} a_2 & & \\ b_2 & h(B) & d_2 \\ & e_2 & \end{array} \right) \right\}.$$

$$\Rightarrow S_n = \left( \begin{array}{ccc} \frac{2na_1+n(n-1)a_2}{2} & \frac{2nh(A)+n(n-1)h(B)}{2} & \frac{2nd_1+n(n-1)d_2}{2} \\ \frac{2nb_1+n(n-1)b_2}{2} & \frac{2ne_1+n(n-1)e_2}{2} & \end{array} \right).$$

Similarly, we can define the Geometric series in terms of rhotrices as follows:

$$U_n = \sum_{k=1}^n [A \circ B^{k-1}]$$

where  $A$  is the first term and  $B$  is the common ratio. The  $n^{th}$  sum is given as:

$$U_n = A \circ \left( \frac{I - B^n}{I - B} \right).$$

$$\Rightarrow U_n = A \circ \{(I - B^n) \circ (I - B)^{-1}\}, \text{ when } h(B) \neq 1.$$

The polynomial equations with variables and coefficients as rhotrices are called the rhotrix polynomial equations. If  $A$  and  $B$  are the real rhotrices as defined in (2), then the equations  $X + A = B$  and  $C \circ Y = D$  have unique solutions, given by  $X = B - A$  and  $Y = D \circ C^{-1}$ , respectively, when  $h(C) \neq 0$ .

## 4. Conclusion

Matrix theory as a whole is a valuable and useful concept in the field of engineering, physics, economics, statistics and various branches of mathematics. Determinant of a matrix was found and used much before the idea of matrix as an algebraic entity emerged and thus the determinant of a matrix is a very practical application. In this article, we focused on some special forms of matrix and properties which make them different yet a powerful tool for solving real life problems.

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## ਸੱਤਾ ਦਾ ਪ੍ਰਵਚਨ : ਮਿਸ਼ੈਲ ਫੂਕੋ

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ਮਾਤਾ ਸੁੰਦਰੀ ਕਾਲਜ, ਦਿੱਲੀ

ਨਿਰਸੰਦੇਹ, ਮਿਸ਼ੈਲ ਫੂਕੋ ਪ੍ਰਵਚਨ, ਸ਼ਕਤੀ, ਗਿਆਨ ਦੇ ਉਹ ਰਿਸ਼ਤੇ ਉਪਜਾਉਣ ਦਾ ਯਤਨ ਕਰਦਾ ਹੈ ਜਿਹੜੇ ਅੱਜ ਸੰਘਵਾਦ ਤੇ ਲੋਕਤੰਤਰ ਸਟੇਟ 'ਚ ਕਾਰਜਸ਼ੀਲ ਹਨ। ਸੁਆਲ ਇਨ੍ਹਾਂ ਦੁਆਰਾ ਸਿਰਫੇ ਪ੍ਰਵਚਨਾਂ ਨੂੰ, ਫੂਕੋ ਦੁਆਰਾ ਦਰਸਾਏ ਗਏ ਨਿਰਦੇਸ਼ਾਂ ਨੂੰ ਆਤਮਸ਼ਾਤ ਕਰਨ ਦੀ ਹੈ ਜਾਂ ਅੱਜ ਸੱਤਾ, ਸਟੇਟ, ਗਿਆਨ, ਨਿਆਂ/ਅਨਿਆਂ ਨਵੇਂ ਦਿਸ਼ਾਵਾਂ ਵੱਲ ਇਸ਼ਾਰਾ ਕਰਨ ਦੀ ਹੈ, ਨੂੰ ਤਲਾਸ਼ਣ ਦਾ ਹੈ। ਇਹ ਨਵੇਂ ਸੰਵਾਦ ਦੇ ਪੁਰਾਣੇ ਰਾਹਾਂ ਨੂੰ ਮੁੜ ਪੁਨਰ-ਸੁਰਜੀਤ ਕਰਨ ਦਾ ਹੈ। ਨਿਆਂ, ਅਨਿਆਂ, ਸਜ਼ਾਵਾਂ, ਨਿਆਂ-ਪ੍ਰਣਾਲੀ ਸਭ ਕੁਝ ਹੈ, ਪਰ ਇਨਸਾਫ਼ ਨਹੀਂ। ਫੂਕੋ ਇਸੇ ਮੰਥਨ 'ਚ ਲਿਖਤਾਂ ਨੂੰ ਪ੍ਰਵਚਨ ਵਜੋਂ ਸਿਰਜਦਾ ਹੈ, ਪਰ ਇਨਾਮ ਹੈ, ਦਰਸ਼ਕ ਨੇ, ਪਰ ਸੁਆਲ ਨਹੀਂ? ਲੋਕਤੰਤਰੀ ਢਾਂਚੇ 'ਚ ਸੁਆਲ ਦਾ ਮਤਲਬ 'ਤੁਸੀਂ ਬਾਗੀ, ਤੁਸੀਂ ਆਕੀ' ਦਾ ਸਿਹਰਾ ਮਿਲਦਾ ਹੈ, ਪਰ ਇਨਸਾਫ਼ ਨਹੀਂ। ਲੋਕਤੰਤਰ ਦੇ ਢਾਂਚੇ 'ਚ ਦਰਅਸਲ ਅੱਜ ਵੀ ਬੁਰਜ਼ੁਆਜੀ ਢਾਂਚਾ ਛੁਪਿਆ ਹੋਇਆ ਹੈ,

ਪੂਰਬਲੀਆਂ ਅਨੁਸ਼ਾਸਨ ਪ੍ਰਣਾਲੀਆਂ ਦੇ ਵਿਰੋਧ ਜਾਂ ਵਿਸਥਾਰ ਵਿਚ 'ਉੱਤਰ' ਰੂਪ ਹੋਂਦ ਵਿਚ ਆਉਂਦੇ ਹਨ। ਇਨ੍ਹਾਂ 'ਉੱਤਰ' ਅੰਤਰ-ਦ੍ਰਿਸ਼ਟੀਆਂ ਦਾ ਪ੍ਰਮੁੱਖ ਪ੍ਰਯੋਜਨ ਸਾਹਿਤ ਆਲੋਚਨਾ ਦੀ ਥਾਂ 'ਤੇ ਸਾਹਿਤ ਸਿਧਾਂਤ ਉੱਪਰ ਬਲ ਦੇਣਾ ਸੀ। ਸਾਹਿਤ-ਆਲੋਚਨਾ ਦਾ ਸੰਬੰਧ ਜਿੱਥੇ ਸਾਹਿਤ ਪਾਠ ਦੀ ਵਿਆਖਿਆ ਤੱਕ ਸੀਮਿਤ ਹੈ, ਉਥੇ ਸਾਹਿਤ ਸਿਧਾਂਤ, ਸਾਹਿਤ ਪਾਠ ਦੀ ਵਿਆਖਿਆ ਤੋਂ ਅਗਾਂਹ ਜਾ ਕੇ ਇਹ ਦਰਸਾਉਂਦਾ ਹੈ ਕਿ ਸਾਹਿਤਕ ਪਾਠ ਅਰਥ ਕਿਵੇਂ ਪੈਦਾ ਕਰਦਾ ਹੈ? ਹੌਲੀ-ਹੌਲੀ ਇਹ ਪ੍ਰਚਲਨ ਇਕ ਸੁਤੰਤਰ ਅਨੁਸ਼ਾਸਨ ਵਜੋਂ ਉੱਭਰਨਾ ਸ਼ੁਰੂ ਹੋ ਗਿਆ, ਜਿਸ ਦਾ ਮੰਤਵ ਸਾਹਿਤਕ, ਕਲਾਤਮਿਕ ਤੇ ਹੋਰ ਸਭਿਆਚਾਰਕ ਸਿਰਜਣਾਵਾਂ ਦੇ ਅਰਥ ਉਤਪਾਦਨ ਦੀ ਕਿਰਿਆ ਬਾਰੇ ਗਿਆਨ ਦੇਣਾ ਹੈ। ਇਸ ਬਦਲਵੇਂ ਪਰਿਪੇਖ ਵਿਚ 'ਉੱਤਰ' ਰੂਪਾਂ ਨੇ ਪੂਰਬਲੇ ਅਨੁਸ਼ਾਸਨਾਂ ਦੇ ਉਲਟ ਪਾਠ ਦੀ ਥਾਂ, ਪਾਠ ਦੇ, ਅਰਥ ਉਤਪਾਦਨ ਦੀ ਕਿਰਿਆ ਨੂੰ ਅਗਰਭੂਮਿਤ ਕਰ ਦਿੱਤਾ। ਸਾਹਿਤਕ ਪਾਠਾਂ ਦੀ ਵਿਆਖਿਆ ਦੀ ਥਾਂ ਵਧੇਰੇ ਵਿਸ਼ਾਲ 'ਸਾਹਿਤਕ ਪ੍ਰਵਚਨ' ਦੀ ਪ੍ਰਕਿਰਤੀ ਅਤੇ ਪ੍ਰਬੰਧ ਵਧੇਰੇ ਧਿਆਨ ਦਾ ਕੇਂਦਰ ਬਣ ਗਿਆ। ਇਸ ਨਵੀਂ ਵਿਧੀ ਨੇ ਉਸ ਸਮੱਗਰੀਵਾਦੀ ਪਹੁੰਚ ਨੂੰ ਰੱਦ ਕਰਨਾ ਸ਼ੁਰੂ ਕਰ ਦਿੱਤਾ, ਜਿਸ ਵਿਚ ਕਿਸੇ ਨਿਸ਼ਚਤ ਸੰਗਠਿਤ ਪਾਠ ਵਿਚੋਂ, ਨਿਸ਼ਚਤ ਅਰਥਾਂ ਦੀ ਤਲਾਸ਼ ਕੀਤੀ ਜਾਂਦੀ ਸੀ। ਇਨ੍ਹਾਂ 'ਉੱਤਰ' ਅਨੁਸ਼ਾਸਨਾਂ ਦਾ ਕਾਰਜ ਨਿਸ਼ਚਤ ਸੰਰਚਨਾ ਵੱਲੋਂ ਦਮਿਤ ਅਨਿਸ਼ਚਤ ਅਰਥਾਂ ਦੀ ਭਾਲ ਕਰਨਾ ਸੀ। ਅਜੋਕੇ ਸਮੇਂ 'ਚ ਸਾਹਿਤ ਦੇ ਅਧਿਐਨ ਦੀ ਵਸਤ ਸਾਹਿਤਕ ਪਾਠ ਨਹੀਂ, ਸਗੋਂ ਪ੍ਰਵਚਨ ਹੈ। ਹੁਣ ਲੇਖਕ ਅਤੇ ਪਾਠ ਦੀ ਥਾਂ ਪ੍ਰਮੁੱਖਤਾ ਪਾਠਕ ਅਤੇ ਆਲੋਚਕ ਨੂੰ ਪ੍ਰਵਾਨਤ ਕਰ ਲਈ ਹੈ। ਸਾਹਿਤ ਦੀ ਸਾਹਿਤਕਤਾ ਦੀ ਥਾਵੇਂ ਉਸ ਦਾ ਅਰਥ ਉਤਪਾਦਨੀ ਕਿਰਿਆ ਵਜੋਂ ਅਤੇ ਉਸ ਦੇ ਹੋਰ ਪ੍ਰਵਚਨਾਂ ਨਾਲ ਸੰਬੰਧਾਂ ਬਾਰੇ ਅਤੇ ਇਸ ਸਾਰੇ ਕੁਝ ਦੇ ਨਾਲ ਸ਼ਕਤੀ ਦਾ ਸੰਬੰਧ ਵਧੇਰੇ ਧਿਆਨਗੋਚਰ ਹੋ ਗਿਆ ਹੈ। ਪਰੰਤੂ ਇਹ ਸਾਰਾ ਵਰਤਾਰਾ

ਅਚਨਚੇਤ ਨਹੀਂ ਵਾਪਰਿਆ ਸਗੋਂ ਇਸ ਦੀ ਪੈਠ ਪੂਰਬਲੇ ਚਿੰਤਨ ਵਿਚੋਂ ਲੱਭੀ ਜਾ ਸਕਦੀ ਹੈ। ਸੂਚਨਾ ਤੇ ਤਕਨਾਲੋਜੀ ਦੇ ਯੁੱਗ ਵਿਚ ਅੱਜ ਹਰ ਵਸਤ-ਵਰਤਾਰਾ ਇਕ ਪਾਠ (text) ਵਜੋਂ ਗ੍ਰਹਿਣ ਕੀਤਾ ਜਾ ਰਿਹਾ ਹੈ। ਪਾਠ ਵਿਚਲੀ ਚਿਹਨਕੀ ਪ੍ਰਕਿਰਿਆ ਤੋਂ ਅਗਾਂਹ ਜਾ ਕੇ ਇਸ ਵਿਚ ਲੁਕੇ/ਛੁਪੇ ਪ੍ਰਵਚਨਾਂ ਨੂੰ ਤਲਾਸ਼ਣ ਦਾ ਰਿਵਾਜ ਤੁਰਿਆ ਹੈ। ਸਾਹਿਤਕ ਪ੍ਰਵਚਨ ਜਿਸ ਭਾਵ-ਜਗਤ ਨੂੰ ਪ੍ਰਗਟ ਕਰਦਾ ਮੰਨਿਆ ਜਾਂਦਾ ਹੈ, ਉਸ ਵਿਚ ਸ਼ਾਮਲ ਤੱਤ ਅਸਲ ਵਿਚ ਸਭਿਆਚਾਰਕ ਚਿਹਨਕ, ਭਾਸ਼ਾ ਦੀ ਸ਼ਬਦਾਵਲੀ ਦਾ ਪਰੰਪਰਾਈ ਪ੍ਰਗਟਾਵਾ ਹੁੰਦੇ ਹਨ।

ਫਰਾਂਸੀਸੀ ਚਿੰਤਕ ਮਿਸ਼ੈਲ ਫੂਕੋ ਨੇ ਆਪਣੀਆਂ ਲਿਖਤਾਂ ਰਾਹੀਂ ਸਮੁੱਚੇ ਵਿਸ਼ਵ ਨੂੰ ਪ੍ਰਭਾਵਤ ਕੀਤਾ। ਉਸ ਦੀਆਂ ਲਿਖਤਾਂ ਵਧੇਰੇ ਜਟਿਲ ਹਨ, ਜਿਸ ਕਾਰਨ ਅਰਥਾਂ ਦੀ ਸਮਝ ਬਣਾਉਣ ਲਈ ਪਾਠ ਅਤੇ ਸੰਕਲਪਾਂ, ਸੰਦਰਭਾਂ ਦੀ ਜੁਸਤਜੁ ਕਰਨੀ ਪੈਂਦੀ ਹੈ। ਮਿਸ਼ੈਲ ਫੂਕੋ ਦਾ ਸਮੁੱਚਾ ਚਿੰਤਨ ਗਿਆਨ, ਸ਼ਕਤੀ/ਸੱਤਾ ਤੇ ਵਿਅਕਤੀ ਦੇ ਸੰਬੰਧਾਂ ਨੂੰ ਜੋੜਨ 'ਚ ਲੱਗਿਆ ਰਿਹਾ। ਉਸ ਦੇ ਚਿੰਤਨ ਵਿਚ 'ਪ੍ਰਵਚਨ' ਵਿਸ਼ੇਸ਼ ਮਹੱਤਤਾ ਦਾ ਧਾਰਨੀ ਰਿਹਾ ਹੈ। ਉਸ ਦੀਆਂ ਪੁਸਤਕਾਂ 'The order of the things', 'The archaeology of knowledge', 'Madness and civilization', 'Discipline & Punish', 'The birth of the clinic', 'History of sexuality (I.II.III)' ਆਦਿ ਪ੍ਰਵਚਨ ਦੇ ਸੰਕਲਪ ਨੂੰ ਪਰਿਭਾਸ਼ਤ ਕਰਦੀਆਂ ਨਜ਼ਰ ਆਉਂਦੀਆਂ ਹਨ। ਉਪਰੋਕਤ ਪੁਸਤਕਾਂ ਦਾ ਸਾਂਝਾ ਥੀਮ ਤੇ ਸੂਤਰ ਗਿਆਨ, ਸੱਤਾ ਤੇ ਵਿਅਕਤੀ ਦੁਆਲੇ ਕੇਂਦਰਿਤ ਹੈ। ਆਪਣੀ ਪੁਸਤਕ 'The archaeology of knowledge' ਵਿਚ ਪ੍ਰਵਚਨ ਨੂੰ ਇਉਂ ਪਰਿਭਾਸ਼ਤ ਕਰਦਾ ਹੈ :

*"Discourse, then, I meant that which was produced (perhaps all that all produced) by the group of signs, but I also meant a group of acts of formulation, a series of sentences or propositions. Lastly - and it is this meaning that was finally used discourse is constituted by a group of sequences of signs in so far as they are statements, that is, in so far as they can be assigned particular modalities of existence."*<sup>1</sup>

ਮਿਸ਼ੈਲ ਫੂਕੋ ਪ੍ਰਵਚਨ ਨੂੰ ਇਕ ਸੰਦ ਵਜੋਂ ਵਰਤਦਾ ਹੈ, ਜਿਸ ਰਾਹੀਂ ਸ਼ਕਤੀ ਹਥਿਆਈ ਜਾਂਦੀ ਹੈ। "ਫੂਕੋ ਦਾ ਮੰਨਣਾ ਹੈ ਕਿ ਸ਼ਕਤੀਸ਼ਾਲੀ ਘੱਟ ਗਿਣਤੀ, ਸ਼ਕਤੀਹੀਣ ਵੱਧ ਗਿਣਤੀ ਨੂੰ ਪ੍ਰਵਚਨ ਦੀ ਤਾਕਤ ਰਾਹੀਂ ਆਪਣੇ ਆਸ਼ੇ ਅਧੀਨ ਢਾਲ ਲੈਂਦੀ ਹੈ। ....ਕੋਈ ਵੀ ਮਾਨਵ ਵਿਗਿਆਨ ਸੱਚ ਜਾਂ ਨਿਰਪੱਖ ਨਹੀਂ ਹੈ। ਇਸ ਤਰ੍ਹਾਂ ਫੂਕੋ ਨੇ ਗਿਆਨ ਦੇ ਸੱਚਾਂ ਜਾਂ ਵਸਤੂਨਿਸ਼ਠ ਹੋਣ ਉੱਤੇ ਸੁਆਲੀਆ ਨਿਸ਼ਾਨ ਲਗਾ ਦਿੱਤਾ ਹੈ।"<sup>2</sup> ਫੂਕੋ ਦੀਆਂ ਲਿਖਤਾਂ ਇਹ ਦ੍ਰਿੜ ਕਰਵਾਉਂਦੀਆਂ ਹਨ ਕਿ ਗਿਆਨ ਤੇ ਸ਼ਕਤੀ ਅੰਤਰ-ਸੰਬੰਧਿਤ ਹਨ। ਜਿਸ ਵਰਗ ਵਿਸ਼ੇਸ਼ ਕੋਲ ਤਾਕਤ ਹੈ, ਉਹ ਵਸਤ-ਵਰਤਾਰਿਆਂ ਨੂੰ ਆਪਣੇ ਅਨੁਸਾਰ ਵਖਿਆਉਂਦੀ ਹੈ। ਫੂਕੋ ਦਾ ਮੰਨਣਾ ਹੈ ਕਿ (ਜੇਲ੍ਹਾਂ, ਪਾਗਲਖਾਨੇ, ਹਸਪਤਾਲ, ਸਕੂਲ) ਆਦਿ ਸੱਤਾ ਸੰਸਥਾਵਾਂ ਦੇ ਪ੍ਰਵਚਨ ਰਾਹੀਂ ਮਨੁੱਖੀ ਆਤਮਪਰਕਤਾ (subjectivity) ਨੂੰ ਖਾਸ ਅਨੁਸ਼ਾਸਨ ਵਿਚ ਢਾਲਣਾ ਹੈ ਤਾਂ ਜੋ ਮਨੁੱਖ ਸਰੀਰਕ ਤੇ ਮਾਨਸਿਕ ਪੱਖੋਂ ਸੱਤਾ ਦੇ ਪਰਾਧੀਨ (ਗੁਲਾਮ) ਰਹੇ। ਫੂਕੋ ਦੀਆਂ ਲਿਖਤਾਂ ਖਾਸ ਕਰ ਕੇ ਸੱਤਾ ਤੇ ਗਿਆਨ ਦੇ ਪ੍ਰਸੰਗ ਵਿਚ, ਉਸ ਨੂੰ ਉਸ ਦੇ ਸਮਕਾਲੀ ਚਿੰਤਕ ਅਲਬਿਊਸਰ ਤੇ ਦੈਰਿਦਾ ਨਾਲੋਂ ਵੀ ਵਖਰਿਆਉਂਦੀਆਂ ਹਨ। ਅਲਬਿਊਸਰ ਦਾ ਵਿਚਾਰ ਹੈ ਕਿ ਰਾਜ ਸੱਤਾ ਆਪਣੇ ਕਾਨੂੰਨਾਂ, ਵਿੱਦਿਅਕ ਸੰਸਥਾਵਾਂ, ਪਰਿਵਾਰ ਤੇ ਨਿਯਮਾਂ, ਸਦਾਚਾਰ ਬਾਰੇ ਧਾਰਨਾਵਾਂ ਆਦਿ ਰਾਹੀਂ ਵਿਚਾਰਧਾਰਾ ਦਾ

ਸੰਚਾਰ ਕਰਦੀ ਹੈ। ਰਾਜ ਸੱਤਾ ਸਿੱਧੇ ਤੌਰ 'ਤੇ ਰੋਕ ਨਹੀਂ ਲਗਾਉਂਦੀ ਪਰ ਲੋਕਾਂ ਨੂੰ ਵਿਗੜਿਆ ਹੋਇਆ ਸੱਚ ਅਤੇ ਭਗਤੀਯੁਕਤ ਜੀਵਨ ਹੀ ਵਿਆਪਕ, ਸੁਭਾਵਿਤ ਅਤੇ ਅੰਤਿਮ ਲਕਸ਼ ਵਾਲਾ ਸਵੀਕਾਰ ਕਰਵਾਈ ਰੱਖਦੀ ਹੈ। ਦਰਅਸਲ ਅਲਥਿਊਸਰ, ਗ੍ਰਾਮਸ਼ੀ ਦੇ ਵਿਚਾਰ ਨੂੰ ਆਤਮਸਾਤ ਕਰਦਾ ਹੈ ਕਿ ਸੱਤਾ ਸਿਰਫ਼ ਤਸੱਦਦ ਦਾ ਸ੍ਰੋਤ ਨਹੀਂ ਹੈ, ਸਗੋਂ ਇਹ ਉਨ੍ਹਾਂ ਜੁਗਤਾਂ ਦਾ ਸਹਾਰਾ ਲੈਂਦੀ ਹੈ, ਜੋ ਪ੍ਰਤੱਖ ਤੌਰ 'ਤੇ ਸੱਭਿਅਕ ਹਨ, ਅਜਿਹਾ ਕਰ ਕੇ ਰਾਜ ਸੱਤਾ ਅਤੇ ਉਹ ਜਮਾਤ ਜੋ ਉਸ ਦੀ ਭਾਈਵਾਲ ਹੈ, ਆਪਣੀ ਪ੍ਰਭੂਤਾ/ਸਰਦਾਰੀ ਕਾਇਮ ਰੱਖਦੀ ਹੈ :

*“Althusser makes a useful distinction between what we might call state power and state control. State power is maintained by what Althusser ..... repressive structures, which are institutions like the law courts, prisons, the police force and the army, which operate, in last analysis by external force. But the power of the state is also maintained more ....., by seeming to secure the internal consent of its citizens, using that what Althusser calls ideological structure or state ideological apparatuses.”<sup>3</sup>*

ਇਸ ਮਸਲੇ ਨੂੰ ਵੱਖਰੇ ਤੇ ਵਿਸ਼ਾ ਅਰਥ ਮਿਸ਼ੈਲ ਫੂਕੋ ਆਪਣੀ ਲਿਖਤਾਂ ਰਾਹੀਂ ਦਿੰਦਾ ਹੈ ਕਿ ‘ਪ੍ਰਵਚਨ ਨੂੰ ਤਾਕਤ ਨਾਲ ਜੋੜਨਾ ਆਪਣੇ-ਆਪ 'ਚ ਅਹਿਮ ਨੁਕਤਾ ਹੈ’। ਮਿਸ਼ੈਲ ਫੂਕੋ ਦਾ ਕਹਿਣਾ ਹੈ ਕਿ ਸਿਆਸੀ ਤੇ ਆਰਥਿਕ ਸਿਸਟਮਾਂ ਅਤੇ ਕਿਸੇ ਸਮਾਜਕ ਦੌਰ ਵਿਚ ਵਿਚਾਰਧਾਰਕ ਸ਼ਕਤੀਆਂ ਦੀ ਪਰਖ ਤਦ ਹੀ ਵਿਗਿਆਨਕ ਹੋਵੇਗੀ ਜੇ ਪ੍ਰਵਚਨ ਵਿਚ ਭਾਸ਼ਾ ਤੇ ਉਕਤੀ ਦੇ ਪਾਰ ‘ਹੋਰ’ (others) ਦੀ ਉਥਾਪਨਾ ਤੇ ਭੰਨਤੋੜ ਕੀਤੀ ਜਾਵੇ। ਇਸ ‘ਹੋਰ’ ਦਾ ਨਾਤਾ ਤਾਕਤ ਦੇ ਰਿਸ਼ਤਿਆਂ ਨਾਲ ਹੈ। ਫੂਕੋ ਪ੍ਰਵਚਨ ਨੂੰ ਹੀ ਤਾਕਤ/ਸੱਤਾ ਆਖਦਾ ਹੈ ਕਿਉਂਕਿ ਕਿਸੇ ਖਾਸ ਯੁੱਗ ਵਿਚ ਗਿਆਨ ਵਿਧਾਵਾਂ ਉੱਪਰ ਉਸੇ ਜਮਾਤ ਦਾ ਕਬਜ਼ਾ ਹੁੰਦਾ ਹੈ, ਜਿਸ ਕੋਲ ਸਿਆਸੀ ਤਾਕਤ ਹੈ। ਇਸ ਤਾਕਤ ਦੀ ਬੁਣਤ ਵਿਚ ਅਨੇਕਾਂ ਮਨਾਹੀਆਂ, ਰੋਕਾਂ, ਡਰ, ਤਸੱਦਦ ਪੈਦਾ ਕਰਨ ਵਾਲੀਆਂ ਮਾਨਵੀ ਅਤੇ ਪ੍ਰਵਚਨੀ ਜੁਗਤਾਂ ਸ਼ਾਮਲ ਹਨ। ਪੁਲਿਸ, ਕਾਨੂੰਨ, ਅਦਾਲਤਾਂ, ਜੇਲ੍ਹਾਂ, ਹਸਪਤਾਲ, ਸਕੂਲਾਂ ਦੀ ਮੌਜੂਦਗੀ ਦੇ ਕਈ ਅਰਥ ਹਨ। ਜਿਵੇਂ ਰੋਕਣਾ, ਅਨੁਸ਼ਾਸਨ ਕਰਨਾ, ਮੁਲਤਵੀ ਕਰਨਾ, ਵਿਚੋਲਗੀ ਰਾਹੀਂ ਸੰਪਰਕ ਸਾਧਣਾ ਕਿ ‘ਸਭ ਠੀਕ-ਠਾਕ ਹੈ’ ਆਦਿ ਪ੍ਰਵਚਨਾਂ ਨੂੰ ਵਰਤਣਾ। ਮਿਸ਼ੈਲ ਫੂਕੋ ਦਾ ਅਹਿਮ ਸੂਤਰ ਇਹ ਹੈ ਕਿ ਸੱਤਾ ਦਾ ਪ੍ਰਵਚਨ ਆਪਣੀ ਹਰ ਜੁਗਤ ਨੂੰ ਤਰਕਸ਼ੀਲ ਤੇ ਸੁਭਾਵਕ, ਮਾਨਵੀ ਤੇ ਸਰਵ-ਸੰਪੰਨ ਪ੍ਰਗਟ ਕਰਦਾ ਹੈ। ਮਿਸ਼ੈਲ ਫੂਕੋ ਦੀ ‘ਸੱਤਾ ਤੇ ਪ੍ਰਵਚਨ’ ਦੀ ਰਣਨੀਤੀ ਨੂੰ ਇਸ ਪ੍ਰਕਾਰ ਸਮਝਿਆ ਜਾ ਸਕਦਾ ਹੈ :

*“Power, then, is a term used by Foucault to describes a series of strategic relations and has following features :*

- 1. Power is coextensive with the social body ;*
- 2. Relation of power are inter concern with other kinds of relations. Production, kinship, family, sexuality ;*

3. *Interconnection of power delineate general conditions of domination organised in a more or less coherent and unitary strategy ;*

4. *They are no relations of power without possible resistances.*”<sup>32</sup>

*“Power is everywhere not because it is all embracing but it comes from everywhere.”*<sup>4</sup>

ਉਪਰੋਕਤ ਦੋਵੇਂ ਪਰਿਭਾਸ਼ਾ ਸ਼ਕਤੀ ਦੀਆਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ ਨੂੰ ਪ੍ਰਗਟਾਉਂਦੀਆਂ ਹਨ। ਫੂਕੋ ਦਾ ਮੰਨਣਾ ਹੈ ਕਿ ਗਿਆਨ ਅਤੇ ਸ਼ਕਤੀ ਦਾ ਅੰਤਰਸੰਬੰਧਿਤ ਹੋਣਾ ਹੀ ਪ੍ਰਵਚਨੀ ਜੁਗਤ ਨੂੰ ਸਿਰਜਦਾ ਹੈ ਪਰ ਉਹ ਇਹ ਵੀ ਮੰਨਦਾ ਹੈ ਕਿ ਸ਼ਕਤੀ ਹਮੇਸ਼ਾ ਤੋਂ ਹੈ, ਗਿਆਨ ਦੇ ਵੱਖੋ-ਵੱਖਰੇ ਪ੍ਰਵਰਗ ਸ਼ਕਤੀ ਵਿਚ ਨਿਰਮਿਤ ਹਨ :

*“Knowledge and power are integrated with one another, and there is no point in dreaming of a time when knowledge will cease to depend on power, .....it is too possible for power to be excused without knowledge, it is impossible for knowledge not to engender power.”*<sup>5</sup>

ਫਰਾਂਸੀਸੀ ਵਿਦਵਾਨ ਚਿੰਤਕ ਯੱਕ ਦੈਰਿਦਾ, ਪੱਛਮੀ ਦਾਰਸ਼ਨਿਕ ਪਰੰਪਰਾ ਨੂੰ ਧੁਨੀ-ਕੇਂਦਰਵਾਦ ਅਤੇ ਸ਼ਬਦ-ਕੇਂਦਰਵਾਦ ਦਾ ਸ਼ਿਕਾਰ ਦੱਸਦਾ ਹੈ। ਦੈਰਿਦੀਅਨ ਪ੍ਰਵਚਨ ਵਿਖੰਡਨ ਰਾਹੀਂ ਸਮੁੱਚੀ ਪੱਛਮੀ ਦਾਰਸ਼ਨਿਕ ਪਰੰਪਰਾ ਨੂੰ ਅਤੇ ਇਸ ਪਰੰਪਰਾ ਦੁਆਰਾ ਸਿਰਜੇ ਪ੍ਰਵਚਨਾਂ ਨੂੰ ਚੁਣੌਤੀ ਦਿੰਦਾ ਹੈ। ਦੈਰਿਦੀਅਨ ਪ੍ਰਵਚਨ ਪੱਛਮੀ ਦਰਸ਼ਨ ਨੂੰ ‘ਪਰਾਭੋਤਿਕਤਾ’ ਦਾ ਸ਼ਿਕਾਰ ਦੱਸਦਾ ਹੈ, ਇਹ ਮੰਨ ਕੇ ਚੱਲਦਾ ਹੈ ਕਿ ਭਾਸ਼ਾ ਦੀ ਤਹਿ ‘ਚ ਕੋਈ ਕੇਂਦਰ ਛੁਪਿਆ ਹੋਇਆ ਹੈ, ਜਿਸ ਨੂੰ ਉਹ ਲੱਭ ਸਕਦੇ ਹਨ। ਇਸ ਤਰ੍ਹਾਂ ਵਿਖੰਡਨ ਪੱਛਮੀ ਦਾਰਸ਼ਨਿਕ ਪਰੰਪਰਾ ਨੂੰ ‘ਮੋਜੂਦਗੀ ਦੇ ਅਧਿਆਤਮ’ ਦਾ ਸ਼ਿਕਾਰ ਮੰਨਦਾ ਹੈ। ਦੈਰਿਦਾ ਅਨੁਸਾਰ ਕੋਈ ਵੀ ਦਰਸ਼ਨ ਸਿਆਸਤ ਤੋਂ ਨਿਰਲੇਪ ਨਹੀਂ ਹੁੰਦਾ। ਵੱਖੋ-ਵੱਖਰੇ ਸੰਕਲਪ, ਧਾਰਵਾਸੇ, ਮਨੋਤਾਂ ਤਾਕਤ/ਸੱਤਾ/ਸ਼ਕਤੀ ਦੀਆਂ ਹੀ ਵੱਖੋ-ਵੱਖਰੀਆਂ ਇਕਾਈਆਂ ਹੁੰਦੇ ਹਨ। ਦੈਰਿਦੀਅਨ ਚਿੰਤਨ ਬਾਖ਼ਤਿਨ ਦੇ ਬਹੁਨਾਦੀ ਪ੍ਰਵਚਨ (Polyphonic Discourse) ਅਤੇ ਮਿਸ਼ੈਲ ਫੂਕੋ ਦੇ ਸ਼ਕਤੀ (Power) ਸੰਕਲਪ ਨਾਲ ਮੇਲ ਖਾਂਦਾ ਹੈ। ਪਰੰਤੂ ਦੈਰਿਦੀਅਨ ਚਿੰਤਨ ਅਤੇ ਮਿਸ਼ੈਲ ਫੂਕੋ ‘ਚ ਮੂਲ ਵੱਖਰਤਾ ਇਹ ਉੱਭਰਦੀ ਹੈ ਕਿ ਦੈਰਿਦੀਅਨ ਵਿਖੰਡਨ ਪਾਠ ਦੇ ਵਿਸ਼ਲੇਸ਼ਣ ਤੱਕ ਸੀਮਤ ਰਹਿੰਦਾ ਹੋਇਆ ਪਾਠ ਦੇ ਅੰਤਰ-ਵਿਰੋਧਾਂ, ਅੰਤਿਮ ਅਰਥਾਂ, ਅੰਤਿਮ ਵਿਆਖਿਆ ‘ਤੇ ਸੱਟ ਮਾਰਦਾ ਹੈ। ਦੈਰਿਦਾ ਤਾਕਤ ਦੀਆਂ ਸੰਸਥਾਵਾਂ ਦੀ ਗੱਲ ਤਾਂ ਕਰਦਾ ਹੈ ਪਰ ਇਨ੍ਹਾਂ ਸੰਸਥਾਵਾਂ ਵੱਲ ਪਰਤਦਾ ਨਹੀਂ, ਜਿਵੇਂ ਮਿਸ਼ੈਲ ਫੂਕੋ ਪਰਤਦਾ ਹੈ। ਉਪਰੋਕਤ ਚਰਚਾ ਰਾਹੀਂ ਮਿਸ਼ੈਲ ਫੂਕੋ ਦੀ ਵੱਖਰਤਾ, ਪ੍ਰਵਚਨ ਦੇ ਸੰਦਰਭ ਵਿਚ ਸੱਤਾ, ਗਿਆਨ ਅਤੇ ਵਿਅਕਤੀ ਦੀ ਭੂਮਿਕਾ ਉਪਰੋਕਤ ਦੋਹਾਂ ਚਿੰਤਕਾਂ ਤੋਂ ਕਿਵੇਂ ਅੱਡਰੀ ਹੈ, ਨੂੰ ਉਭਾਰਨਾ ਵੀ ਹੈ। ਤਿੰਨਾਂ ਹੀ ਚਿੰਤਕਾਂ ਦਾ ਸਾਂਝਾ ਸੂਤਰ ਇਹ ਹੈ ਕਿ ਕਿਸੇ ਵੀ ਨਿਰਪੇਖ ਗਿਆਨ, ਸੱਚ, ਏਕਤਾ, ਅਰਥਾਂ ਦੀ ਨਿਰੰਕੁਸ਼ਤਾ, ਸਥਾਪਤੀ ਨੂੰ ਚੁਣੌਤੀ ਦੇਣਾ ਹੈ। ਪਰੰਤੂ ਖਾਲਸ ਸੱਤਾ ਦੇ ਪ੍ਰਵਚਨ, ਉਸ ਦੀ ਪ੍ਰਕਿਰਤੀ, ਸਰੂਪ ਤੇ ਇਸ ਦੀਆਂ ਸੰਭਾਵਨਾਵਾਂ ਮਿਸ਼ੈਲ ਫੂਕੋ ਦੀਆਂ ਵਿਚੋਂ ਹੀ ਮਿਲਦੀਆਂ ਹਨ ਕਿਉਂਕਿ ਉਹ ਵਿਸਥਾਰ ‘ਚ ਸੰਸਥਾਵਾਂ ਵਿਚ ਦਖਲ ਦਿੰਦਾ ਹੈ। ਪ੍ਰਵਚਨ, ਪ੍ਰਵਚਨਾਤਮਕ ਸ਼ੈਲੀ ਤੇ ਗਲਬੇ ਦੀ ਜੜ੍ਹ (Roots) ਨੂੰ ਪੁਰਾਤੱਤਵ ਵਿਗਿਆਨ ‘ਚੋਂ ਖੰਘਾਲਦਾ ਹੈ ਕਿਉਂਕਿ ਫੂਕੋ ਇਹ ਮੰਨਦਾ ਹੈ

ਕਿ ਸ਼ਕਤੀ ਦਾ ਪਾਸਾਰਾ ਇਕਹਿਰਾ ਨਹੀਂ, ਇਹ ਬਹੁ-ਪਸਾਰੀ ਹੈ ਤੇ ਗਿਆਨ ਤੋਂ ਪਹਿਲਾਂ ਹੈ। ਜਦਕਿ ਗਿਆਨ ਜਦੋਂ ਸ਼ਕਤੀ/ਸ਼ੱਤਾ ਦਾ ਮਾਧਿਅਮ ਬਣਦਾ ਹੈ ਤਾਂ 'ਹਿੰਸਾਤਮਕ' ਰੁਝਾਨ ਵੀ ਸੱਭਿਅਕ ਹੋ ਗੁਜ਼ਰਦਾ ਹੈ ਕਿਉਂਕਿ ਹਾਕਮੀਅਤ ਦਾ ਉਦੇਸ਼ ਤਸ਼ੱਦਦ ਨਹੀਂ ਸਗੋਂ ਹਰ ਵਤੀਰੇ ਦਾ ਇਸਤੇਮਾਲ ਕਰ, ਲੋਕਾਈ ਨੂੰ ਆਪਣੀ ਭਾਸ਼ਾ ਸਿਖਾਉਣਾ ਹੈ। ਮਿਸ਼ੈਲ ਫੂਕੋ ਇਹ ਵੀ ਮੰਨਦਾ ਹੈ ਕਿ ਜਿੱਥੇ ਵੀ ਸ਼ੱਤਾ ਦਾ ਪ੍ਰਵਚਨ ਹੋਏਗਾ, ਉਥੇ ਪ੍ਰਤੀਰੋਧ ਵਾਜ਼ਿਬ ਹੈ। ਪ੍ਰਤੀਰੋਧ ਦਾ ਹੋਣਾ ਹੀ ਸ਼ੱਤਾ ਦੇ ਪ੍ਰਵਚਨ ਦੀ ਮੌਜੂਦਗੀ ਦਾ ਲਖਾਇਕ ਹੈ। ਪਰੰਤੂ ਇਸ ਪ੍ਰਤੀਰੋਧ ਨੂੰ ਪ੍ਰਾਧੀਨ (ਗੁਲਾਮ/ਅਧੀਨ) ਕਰਨ ਲਈ ਵੱਖੋ-ਵੱਖਰੇ ਨੈੱਟਵਰਕ ਵੀ ਕਾਰਜਸ਼ੀਲ ਹਨ।

ਇਸੇ ਲਈ ਮਿਸ਼ੈਲ ਫੂਕੋ 'ਪਾਵਰ ਇਨ ਨਾਲਿਜ਼' (Power in knowledge) ਨਿਬੰਧ ਵਿਚ ਕਹਿੰਦਾ ਹੈ ਕਿ "ਤਾਕਤ ਤੋਂ ਮੇਰਾ ਭਾਵ ਗੁਲਾਮ ਬਣਾਉਣ ਵਾਲੇ ਤੌਰ ਤਰਕਿਆਂ ਤੋਂ ਨਹੀਂ, ਜੋ ਹਿੰਸਾ ਦੀ ਥਾਂ, ਕਾਨੂੰਨ ਬਣਾ ਕੇ ਆਪਣਾ ਕੰਮ ਕਰਦੇ ਹਨ। ਮੈਂ ਇਕ ਸਮੂਹ ਦੀ ਦੂਜੇ ਸਮੂਹ ਉੱਤੇ ਦਾਬੇ ਦੀ ਗੱਲ ਵੀ ਨਹੀਂ ਕਰ ਰਿਹਾ। ਇਹ ਸਾਰੀਆਂ ਚੀਜ਼ਾਂ ਤਾਂ ਤਾਕਤ/ਸ਼ਕਤੀ ਸੰਰਚਨਾਵਾਂ ਦੇ ਅੰਤਿਮ-ਪਰਿਣਾਮ ਹਨ। ਤਾਕਤ ਨੂੰ ਉਨ੍ਹਾਂ ਸ਼ਕਤੀ ਸੰਬੰਧਾਂ ਵਿਚ ਵੇਖਣਾ ਚਾਹੀਦਾ ਹੈ ਜੋ ਆਪਣਾ ਇਕ 'ਮੈਕਨਿਜ਼ਮ' ਬਣਾਉਂਦੇ ਹਨ। ਇਹਦਾ ਆਪਣਾ ਇਕ ਚਰਿੱਤਰ ਹੈ। ਇਸ ਵਿਚ ਸੰਘਰਸ਼, ਦਵੰਦ, ਰੂਪਾਂਤਰਣ, ਸ਼ਕਤੀ ਸੰਗਠਨ ਅਤੇ ਬਿਖਰਾਉ ਦਾ ਸਿਲਸਿਲਾ ਹੁੰਦਾ ਹੈ।"<sup>35</sup>

ਮਿਸ਼ੈਲ ਫੂਕੋ ਅਨੁਸਾਰ ਗਿਆਨ ਹੀ ਸ਼ੱਤਾ ਹੈ ਅਤੇ ਸ਼ੱਤਾ ਫਿਰ ਆਪਣੇ ਵਿਚਾਰ ਨੂੰ ਲੋਕਾਂ ਦੇ ਅੰਦਰ ਘਰ ਕਰਨ ਲਈ ਪ੍ਰਵਚਨ ਦੀ ਜ਼ਰੂਰਤ ਹੈ। ਫੂਕੋ ਇਸ ਨੂੰ 'ਧਾਰਨਾਵਾਂ ਦਾ ਜੁੱਟ' (Group of statements) ਆਖਦਾ ਹੈ। ਧਾਰਨਾਵਾਂ ਦੇ ਜੁੱਟਾਂ ਦੀ ਨਿਰੰਤਰਤਾ ਹੀ ਪ੍ਰਵਚਨ ਦੀ ਤਾਕਤ ਹੈ। ਫੂਕੋ ਨੇ ਮਨੁੱਖੀ ਸੁਤੰਤਰਤਾ ਦੀ ਬਹਾਲੀ ਬਾਰੇ ਵੀ ਵਿਸਥਾਰਪੂਰਵਕ ਚਰਚਾ ਕੀਤੀ ਹੈ। ਉਹ ਸੁਝਾਅ ਦਿੰਦਾ ਹੈ ਕਿ ਜਦੋਂ ਤੱਕ ਗਿਆਨ ਅਤੇ ਨਿਆਂ ਸੰਸਥਾਵਾਂ ਦਾ ਜੋੜ ਨਹੀਂ ਟੁੱਟਦਾ, ਉਦੋਂ ਤੱਕ ਗੁਲਾਮ ਦੇਹ ਆਜ਼ਾਦ ਨਹੀਂ ਹੋ ਸਕਦੀ। ਇਸ ਜੋੜ ਨੂੰ ਤੋੜਨ ਦਾ ਅਰਥ ਵੱਡੇ ਪੱਧਰ ਦੀ ਤਬਦੀਲੀ ਅਤੇ ਇਸ ਲਈ ਜ਼ਿੰਮੇਵਾਰ ਵਰਗਾਂ ਨੂੰ ਨਾਸ਼ ਕਰਨਾ ਹੀ ਹੋਵੇਗਾ :

*"Discourse is not a way of speaking or writing, but the whole 'mental set' and ideology which encloses the thinking of all members of a given society. It is not singular and monolithic - there is always a multiplicity of discourses - so that operation of power structure is as significant a factor... Foucault's work looks at the institutions which enable this power to be maintained, such as a state punishment, prisons, the medical profession and legislation about sexuality... all of these concern the way power is internalized by those whom it disempowers, so that it does not have to be constantly enforced externally."*<sup>36</sup>

ਉਪਰੋਕਤ ਟਿੱਪਣੀ ਤੋਂ ਸਹਿਜੇ ਸਪੱਸ਼ਟ ਹੋ ਜਾਂਦਾ ਹੈ ਕਿ ਫੂਕੋ ਗਿਆਨ ਨੂੰ ਅਜੋਕੇ ਯੁੱਗ ਦੀ ਸ਼ਕਤੀ/ਤਾਕਤ ਮੰਨਦਾ ਹੈ। ਇਹ ਤਾਕਤ, ਲੋਕਾਈ ਦੀ ਆਪਣੀ ਮਰਜ਼ੀ ਮੁਤਾਬਿਕ ਮਾਨਸਿਕਤਾ ਘੜਦੀ ਹੈ, ਜਿਸ

ਨਾਲ ਮਨੁੱਖੀ ਦੇਹ ਉਤਪਾਦਨੀ ਤੇ ਗੁਲਾਮ ਹੋ ਕੇ ਰਹਿ ਜਾਂਦੀ ਹੈ। ਫੂਕੋ ਦੀਆਂ ਲਿਖਤਾਂ ਵਿਚ ਅਜਿਹੇ ਹੀ ਪ੍ਰਵਚਨ ਦਾ ਸਿਖਰ, ਉਸ ਦੀਆਂ ਤਿੰਨ ਭਾਗਾਂ 'ਚ ਛਪੀ ਪੁਸਤਕ (The History of Sexuality I, II, III) ਵਿਚ

ਵੇਖਣ ਨੂੰ ਮਿਲਦਾ ਹੈ। ਇਨ੍ਹਾਂ ਤਿੰਨਾਂ ਭਾਗਾਂ ਵਿਚ ਕਾਮ ਰੁਚੀਆਂ ਨਾਲ ਸੰਬੰਧਤ ਜਿਹੜੇ ਪ੍ਰਵਰਗ ਪ੍ਰਮੁੱਖ ਤੌਰ 'ਤੇ ਉੱਭਰਦੇ ਹਨ, ਉਹ ਇਸ ਪ੍ਰਕਾਰ ਹਨ : 1. ਵਰਜਣਾਂ, 2. ਖੁੱਲ੍ਹ, 3. ਕੰਟਰੋਲ ਅਤੇ ਇਹ ਤਿੰਨਾਂ ਪ੍ਰਵਰਗਾਂ 'ਤੇ ਤਾਕਤਵਰ ਧਿਰ ਦਾ ਗਲਬਾ ਹੈ। ਪੁਸਤਕ ਦੇ ਪਹਿਲੇ ਭਾਗ ਵਿਚ ਫੂਕੋ ਇਹ ਦਰਸਾਉਂਦਾ ਹੈ ਕਿ ਮੁੱਢਲੇ ਸਮਿਆਂ 'ਚ 'ਕਾਮ' ਸ਼ਬਦ ਨੂੰ ਸਮਾਜਿਕ ਖੁੱਲ੍ਹ ਨਹੀਂ ਸੀ ਪਰ ਕਾਮ ਕਿ ਪ੍ਰਵਰਗ ਦੇ ਤੌਰ 'ਤੇ ਸਮਾਜ ਵਿਚ ਹਾਜ਼ਰ ਸੀ। ਇਸ ਦੀ ਮੌਜੂਦਗੀ ਵਿਆਹ ਸੰਸਥਾ ਤੀਕ ਮਹਿਦੂਦ ਸੀ। ਫੂਕੋ ਇਸ ਲਈ ਰੋਮ ਅਤੇ ਯੂਨਾਨੀ ਜੀਵਨ ਨੂੰ ਆਧਾਰ ਬਣਾਉਂਦਾ ਹੈ। ਜਿੱਥੇ ਕਾਮ ਅਤੇ ਕਾਮੁਕ ਅੰਗਾਂ ਬਾਰੇ ਚਰਚਾ ਕਰਨਾ ਵੀ ਵਰਜਿਤ ਸੀ। ਪਰੰਤੂ 17ਵੀਂ ਸਦੀ, ਜੋ ਪੁਨਰ-ਜਾਗਰਣ ਕਾਲ ਨਾਲ ਸੰਬੰਧਿਤ ਸੀ, ਅਜਿਹੇ ਕਾਲ ਵਿਚ ਸੱਤਾ ਜਦੋਂ ਕਾਮ ਵਰਗੇ ਪ੍ਰਵਰਗ ਵਿਚ ਦਖਲ ਦਿੰਦੀ ਹੈ ਤਾਂ ਭੋਗ-ਵਿਲਾਸ ਪ੍ਰਤਿ ਉਨ੍ਹਾਂ ਦਾ ਰਵੱਈਆ ਨਰਮਾ ਜਾਂਦਾ ਹੈ। ਲੋਕਾਂ 'ਚ ਉਤੇਜਨਾ ਵਧਦੀ ਹੈ। ਸੱਤਾ ਦੀ ਦਖਲਅੰਦਾਜ਼ੀ ਨਾਲ ਕਾਮ ਨਾਲ ਸੰਬੰਧਿਤ ਰੁਚੀਆਂ ਨੂੰ ਬਲ ਮਿਲਦਾ ਹੈ। ਸੱਤਾ/ਸ਼ਕਤੀ ਨਾਲ ਸੰਪੰਨ ਹਾਕਮੀ ਧਿਰ ਵੀ ਕਾਮ ਦਾ ਆਨੰਦ ਮਾਣਦੀ ਹੈ ਤੇ ਲੋਕਾਈ ਵੀ। ਇਹ ਚਰਚਾ ਪੁਸਤਕ ਦੇ ਦੂਜੇ ਭਾਗ ਵਿਚ ਵਿਸਥਾਰਪੂਰਵਕ ਦਰਜ ਹੈ। ਪਰੰਤੂ ਪੁਸਤਕ ਦੇ ਆਖਰੀ ਭਾਗ (ਤੀਸਰੇ) ਵਿਚ ਜਨਸੰਖਿਆ ਦਾ ਵਾਧਾ ਕਾਮੁਕ ਰੁਚੀਆਂ ਨੂੰ ਢਾਹ ਲਗਾਉਂਦਾ ਹੈ। ਸੱਤਾ ਧਿਰ ਜਿੱਥੇ ਇਸ ਪ੍ਰਵਰਗ 'ਚ ਦਖਲ-ਅੰਦਾਜ਼ੀ ਕਰ ਖੁੱਲ੍ਹ ਬਖਸ਼ਦੀ ਹੈ, ਉਥੇ ਸਮਾਜਿਕ ਤਾਣੇ-ਬਾਣੇ ਨੂੰ ਦਰੁਸਤ ਕਰਨ ਹਿੱਤ ਇਸ ਪ੍ਰਵਰਗ 'ਤੇ ਕੰਟਰੋਲ ਸਥਾਪਤ ਵੀ ਕਰਦੀ ਹੈ। ਸੋ, ਕਾਮ ਜਿਹਾ ਪ੍ਰਵਰਗ ਜਦੋਂ ਸੱਤਾ/ਤਾਕਤ ਦੇ ਹੱਥਾਂ ਵਿਚ ਆਉਂਦਾ ਹੈ ਤਾਂ ਮਨੁੱਖ ਭੋਗ-ਵਿਲਾਸ ਦੀ validity ਨਿਸਚਤ ਹੋ ਜਾਂਦੀ ਹੈ। ਇਹ ਹੀ ਸੱਤਾ ਦਾ ਪ੍ਰਵਚਨ ਹੈ, ਜਿਸ ਦੇ ਅੰਤਰਗਤ ਮਨੁੱਖੀ ਅਕਾਂਖਿਆਵਾਂ, ਜਜ਼ਬਾਤ, ਰੀਝਾਂ, ਨਿੱਜਤਾ, ਖੁਸ਼ਹਾਲੀ ਆਦਿ 'ਸੁਤੰਤਰਤਾ' ਸ਼ਬਦ ਪਿੱਛੇ ਨਜ਼ਰਬੰਦ ਹੁੰਦੀ ਹੈ :

*“All these negative element - defenses, censorship, denials which the repressive hypothesis groups together in one greet central mechanism destined to say no, are doubtless only component parts that have a local and tactical role to play in a transformation into discourse, a technology of power, and a will to knowledge that are far from being reducible to the former.... that techniques of power exercised over sex have not obeyed a principle of rigorous selection but rather one of dissemination and implantation of polymorphous sexuality.”<sup>7</sup>*

ਇਸ ਪ੍ਰਕਾਰ ਮਿਸ਼ੈਲ ਫੂਕੋ ਦੇ ਚਿੰਤਨ ਵਿਚ ਇਕਹਿਰੇ ਸਰਬ-ਵਿਆਪੀ, ਨਿਸਚਤ ਵਰਤਾਰਿਆਂ ਦੀ ਡਟ ਕੇ ਆਲੋਚਨਾ ਹੋਈ ਹੈ। ਉਸ ਦੇ ਵਿਚਾਰਾਂ ਰਾਹੀਂ ਸਮਾਜ, ਮਨੁੱਖ, ਘੱਟ-ਗਿਣਤੀ, ਬਹੁ-ਗਿਣਤੀ ਤੇ ਗਿਆਨ ਤੰਤਰਾਂ ਦੇ ਸਾਰੇ ਵਸੀਲੇ ਬੜੀ ਸੂਖਮਤਾ ਰਾਹੀਂ ਸਮਝੇ ਜਾ ਸਕਦੇ ਹਨ।

ਸਮੁੱਚੇ ਰੂਪ 'ਚ ਕਿਹਾ ਜਾ ਸਕਦਾ ਹੈ ਕਿ ਫੂਕੋ ਦੀਆਂ ਵੱਖ-ਵੱਖ ਪੁਸਤਕਾਂ 'ਚ ਪ੍ਰਵਚਨ ਅਹਿਮ ਸੰਦ ਹੀ ਨਹੀਂ ਸਗੋਂ ਫੂਕੋ ਦੀਆਂ ਲਿਖਤਾਂ ਦਾ ਮੂਲ ਥੀਮ ਹੈ। ਫੂਕੋ ਆਪਣੀਆਂ ਲਿਖਤਾਂ ਰਾਹੀਂ ਇਹ ਦੇਖਣਾ ਚਾਹੁੰਦਾ ਹੈ ਕਿ ਗਿਆਨ ਅਤੇ ਸ਼ਕਤੀ/ਸੱਤਾ ਤੰਤਰ ਦਾ ਇਹ ਜੋੜ ਇਤਿਹਾਸ ਦੇ ਵੱਖ-ਵੱਖ ਪੜਾਵਾਂ ਵਿਚ ਆਪਣਾ

ਪ੍ਰਭਾਵ/ਰੋਅਬ ਕਿਵੇਂ ਜਮਾਉਂਦਾ ਹੈ ? ਉਹ ਪ੍ਰਵਚਨ ਨੂੰ ਸ਼੍ਰੇਣੀਬੱਧ ਨਹੀਂ ਕਰਦਾ ਪਰ ਫਿਰ ਵੀ ਉਹ ਸ਼੍ਰੇਣੀਆਂ ਬਣਾਉਂਦਾ ਜਾਂਦਾ ਹੈ ਜਿਵੇਂ : Discursive formation, episteme, Mechanism, Bio-power ਆਦਿ। ਉਹ ਨਿਰੰਤਰ ਚੱਲੇ ਆ ਰਹੇ ਪ੍ਰਵਚਨਾਤਮਕ ਭ੍ਰਾਂਤੀਆਂ ਨੂੰ 'Discursive Formation' ਦੀ ਸ਼੍ਰੇਣੀ 'ਚ ਰੱਖਦਾ ਹੈ। ਇਥੇ Discursive Formation ਤੋਂ ਭਾਵ ਲਗਾਤਾਰ ਚੱਲੇ ਆ ਰਹੇ ਪ੍ਰਵਚਨ ਦੀ ਕ੍ਰਮਬੱਧਤਾ ਨੂੰ ਕ੍ਰਮਭੰਗਤਾ 'ਚ ਤਬਦੀਲ ਕਰਨਾ ਹੈ। ਮਿਸ਼ੈਲ ਫੂਕੋ ਸੰਕਲਪਾਂ ਦੀ ਨਿਸ਼ਚਿਤਤਾ 'ਚ ਕੈਦ ਨਹੀਂ ਰਹਿੰਦਾ ਪਰ ਫੇਰ ਵੀ ਉਹ ਸੰਕਲਪ ਸਿਰਜਣ 'ਚ ਤਹਿਵੀਲ ਹੋ ਜਾਂਦਾ ਹੈ। ਉਸ ਦਾ ਸਮੁੱਚਾ ਚਿੰਤਨ ਸੱਤਾ, ਪ੍ਰਵਚਨ, ਗਿਆਨ ਤੀਕ ਸੀਮਤ ਹੈ ਪਰ ਉਸ ਦੀਆਂ ਵਿਆਖਿਆਵਾਂ ਸੀਮਤਾਈਆਂ ਨੂੰ ਤੋੜਦੀਆਂ ਵੀ ਹਨ। ਹਰ ਲਿਖਤ ਦੇ ਬਾਅਦ ਇੰਟਰਵਿਊ ਦੌਰਾਨ ਇਹ ਕਹਿਣ ਦੇਣਾ ਕਿ "ਮੈਂ ਇਹ ਨਾ ਪੁੱਛੋ ਕਿ ਮੈਂ ਪਹਿਲਾਂ ਕੀ ਕਿਹਾ ? ਇਹ ਪੁੱਛੋ ਕਿ ਮੈਂ ਹੁਣ ਕੀ ਲਿਖ ਰਿਹਾ।" ਫੂਕੋ, ਪ੍ਰਵਚਨ ਨੂੰ ਆਧਾਰ ਬਣਾ ਕੇ ਆਪਣੇ ਸੰਕਲਪਗਤ ਵਿਚਾਰ ਤਾਂ ਪੇਸ਼ ਕਰ ਦਿੰਦਾ ਹੈ ਪਰ ਆਪ ਸੰਕਲਪੀ ਨਹੀਂ ਹੁੰਦਾ। ਇਹ ਹੀ 'ਉੱਤਰ' ਰੂਪ ਦੀ ਨਿਸ਼ਾਨੀ ਹੈ।

ਨਿਰਸੰਦੇਹ, ਮਿਸ਼ੈਲ ਫੂਕੋ ਪ੍ਰਵਚਨ, ਸ਼ਕਤੀ, ਗਿਆਨ ਦੇ ਉਹ ਰਿਸ਼ਤੇ ਉਪਜਾਉਣ ਦਾ ਯਤਨ ਕਰਦਾ ਹੈ ਜਿਹੜੇ ਅੱਜ ਸੰਘਵਾਦ ਤੇ ਲੋਕਤੰਤਰ ਸਟੇਟ 'ਚ ਕਾਰਜਸ਼ੀਲ ਹਨ। ਸੁਆਲ ਇਨ੍ਹਾਂ ਦੁਆਰਾ ਸਿਰਜੇ ਪ੍ਰਵਚਨਾਂ ਨੂੰ, ਫੂਕੋ ਦੁਆਰਾ ਦਰਸਾਏ ਗਏ ਨਿਰਦੇਸ਼ਾਂ ਨੂੰ ਆਤਮਸਾਤ ਕਰਨ ਦੀ ਹੈ ਜਾਂ ਅੱਜ ਸੱਤਾ, ਸਟੇਟ, ਗਿਆਨ, ਨਿਆਂ/ਅਨਿਆਂ ਨਵੇਂ ਦਿਸ਼ਾਵਾਂ ਵੱਲ ਇਸ਼ਾਰਾ ਕਰਨ ਦੀ ਹੈ, ਨੂੰ ਤਲਾਸ਼ਣ ਦਾ ਹੈ। ਇਹ ਨਵੇਂ ਸੰਵਾਦ ਦੇ ਪੁਰਾਣੇ ਰਾਹਾਂ ਨੂੰ ਮੁੜ ਪੁਨਰ-ਸੁਰਜੀਤ ਕਰਨ ਦਾ ਹੈ। ਨਿਆਂ, ਅਨਿਆਂ, ਸਜ਼ਾਵਾਂ, ਨਿਆਂ-ਪ੍ਰਣਾਲੀ ਸਭ ਕੁਝ ਹੈ, ਪਰ ਇਨਸਾਫ਼ ਨਹੀਂ। ਫੂਕੋ ਇਸੇ ਮੰਥਨ 'ਚ ਲਿਖਤਾਂ ਨੂੰ ਪ੍ਰਵਚਨ ਵਜੋਂ ਸਿਰਜਦਾ ਹੈ, ਪਰ ਇਨਾਮ ਹੈ, ਦਰਸ਼ਕ ਨੇ, ਪਰ ਸੁਆਲ ਨਹੀਂ ? ਲੋਕਤੰਤਰੀ ਢਾਂਚੇ 'ਚ ਸੁਆਲ ਦਾ ਮਤਲਬ 'ਤੁਸੀਂ ਬਾਗ਼ੀ, ਤੁਸੀਂ ਆਕੀ' ਦਾ ਸਿਹਰਾ ਮਿਲਦਾ ਹੈ, ਪਰ ਇਨਸਾਫ਼ ਨਹੀਂ। ਲੋਕਤੰਤਰ ਦੇ ਢਾਂਚੇ 'ਚ ਦਰਅਸਲ ਅੱਜ ਵੀ ਬੁਰਜ਼ੁਆਜ਼ੀ ਢਾਂਚਾ ਛੁਪਿਆ ਹੋਇਆ ਹੈ, ਜੋ ਨਿਰਪੱਖ ਸੱਚ, ਏਕਤਾ ਦੀ ਦੁਹਾਈ ਤਾਂ ਦਿੰਦਾ ਹੈ ਪਰੰਤੂ ਧਮਾਕਾ (ਵਿਸਫੋਟ) ਉਸ ਏਕਤਾ 'ਤੇ ਸੁਆਲੀ ਨਿਸ਼ਾਨ ਲਗਾ ਦਿੰਦਾ ਹੈ ਅਤੇ 'ਅਖੰਡ ਸਟੇਟ' ਪ੍ਰਸ਼ਨਚਿੰਨ੍ਹਤ ਹੋ ਜਾਂਦੀ ਹੈ।



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## ਤੂੰ ਹੀ ਦਸ -ਇਕ ਅਧਿਐਨ

ਸੰਖੇਪ ਸਾਰ—ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ ਬਾਰੇ—ਕਹਾਣੀ ਤੂੰ ਹੀ ਦਸ—ਨਿਵੇਕਲੇ ਵਿਸ਼ਾ ਵਸਤੂ ਬਾਰੇ ਚਰਚਾ-ਖੂਬਸੂਰਤ ਔਰਤ ਦੀ ਮਾਨਸਿਕਤਾ---ਉਸ ਦਾ ਜਨੂੰਨ—ਕਹਾਣੀਕਾਰ ਵਲੋਂ ਵਿਸ਼ੇ ਦਾ ਨਿਭਾ—ਸੰਜਮ ਅਤੇ ਸੰਖੇਪ ਸ਼ੈਲੀ।

ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਹਾਣੀ ਵਿਚ ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ ਕਿਸੇ ਪਛਾਣ ਦਾ ਮੁਥਾਜ ਨਹੀਂ ਹੈ। ਸਗੋਂ ਵਿਰਕ ਦੀਆਂ ਕਹਾਣੀਆਂ, ਪੰਜਾਬੀ ਕਹਾਣੀ ਦੀ ਪਛਾਣ ਬਣਾਉਂਦੀਆਂ ਹਨ। ਅੰਮ੍ਰਿਤਾ ਪ੍ਰੀਤਮ ਦੇ ਵਿਚਾਰ ਅਨੁਸਾਰ,

‘ਵਿਰਕ ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਵਰਿਸ ਹੈ-----ਵਿਰਕ ਨਿੱਕੀ ਕਹਾਣੀ ਦਾ ਬਾਦਸ਼ਾਹ ਹੈ। ਚੈਖਵ ਵਾਂਗੂ ਛੋਟੀਆਂ ਛੋਟੀਆਂ ਗੱਲਾਂ ਤੇ ਛੋਟੀਆਂ ਛੋਟੀਆਂ ਘਟਨਾਵਾਂ ਦੇ ਦੁਆਲੇ ਉਹ ਆਪਣੀ ਕਹਾਣੀ ਉਠਦਾ ਹੈ(1)

ਵਿਰਕ ਦੀਆਂ ਕਹਾਣੀਆਂ ਮੂਲ ਮਨੁੱਖੀ ਸਰੋਕਾਰਾਂ ਨਾਲ ਜੁੜੀਆਂ ਹਨ। ਉਹ ਆਪਣੀਆਂ ਕਹਾਣੀਆਂ ਵਿਚ ਪੇਂਡੂ ਜੀਵਨ ਅਤੇ ਸ਼ਹਿਰੀ ਮਧ ਸ਼੍ਰੇਣੀ ਦੀ ਗਲ ਕਰਦਾ ਹੈ। ਵੰਡ ਨੂੰ ਲੈ ਕੇ ਲਿਖੀਆਂ ਉਸ ਦੀਆਂ ਕਹਾਣੀਆਂ ਬੇਜੋੜ ਹਨ। ਵਿਰਕ ਦੇ ਆਪਣੇ ਵਿਚਾਰ ਅਨੁਸਾਰ,

‘ਮੇਰੀਆਂ ਕਹਾਣੀਆਂ ਵਿਚ ਇਕ ਮੋਟੀ ਗਲ ਇਹ ਹੈ ਕਿ ਇਨ੍ਹਾਂ ਦਾ ਪਿੰਡਾ ਪਰਾਣੀਆਂ ਯਾਦਾਂ ਹਨ। ਛੋਟੇ ਹੁੰਦੇ ਤੋਂ ਲੈ ਕੇ ਹੁਣ ਤੱਕ ਜੋ ਜੀਵਨ ਮੈਂ ਜੀਵਿਆ ਹੈ ਉਸ ਵਿਚਲੀਆਂ ਘਟਨਾਵਾਂ ਤੇ ਵਾਪਰੀਆਂ ਬਾਰੇ ਜੋ ਕੁਝ ਮੈਨੂੰ ਯਾਦ ਹੈ ਉਹ ਮੇਰੀਆਂ ਕਹਾਣੀਆਂ ਵਿਚ ਆਉਂਦਾ ਹੈ।,(2)

ਵਿਰਕ ਦੀਆਂ ਕਹਾਣੀਆਂ ਬਾਰੇ ਚਰਚਾ ਕਰਦੇ ਸਮੇਂ ਅਕਸਰ ਲੋਕ ਛਾਹ ਵੇਲਾ, ਤੂੜੀ ਦੀ ਪੰਡ, ਧਰਤੀ ਹੇਠਲਾ ਬੋਲਦ, ਓਪਰੀ ਧਰਤੀ, ਖੱਬਲ, ਸ਼ੇਰਨੀਆਂ, ਮੁਰਦੇ ਦੀ ਤਾਕਤ, ਦੁੱਧ ਦਾ ਛੱਪੜ ਆਦਿ ਦੀ ਗਲ ਕਰਦੇ ਹਨ ਪਰ ਵਿਰਕ ਦੀ ਕਹਾਣੀ ਤੂੰ ਹੀ ਦਸ ਵਿਸ਼ੇ ਦੀ ਚੋਣ ਅਤੇ ਨਿਭਾ ਪਖੋਂ ਵਿਸ਼ੇਸ਼ ਧਿਆਨ ਦੀ ਮੰਗ ਕਰਦੀ ਹੈ।

ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ ਦੀ ਇਹ ਕਹਾਣੀ ਇਕ ਨਿਵੇਕਲੇ ਅਤੇ ਮਹੱਤਵਪੂਰਨ ਵਿਸ਼ੇ ਨਾਲ ਜੁੜੀ ਹੈ। ਇਨਸਾਨ ਦੀ ਮੁੱਢ ਕਦੀਮੀ ਭੁੱਖ ਹੈ ਕਿ ਉਹ ਚਾਹੁੰਦਾ ਹੈ ਕਿ ਮੈਂ ਸਭ ਤੋਂ ਸ਼੍ਰੇਸ਼ਠ ਹੋਵਾਂ। ਗੁਣ ਵਿਚ, ਰੁਤਬੇ ਵਿਚ, ਦਰਜੇ ਵਿਚ, ਪੈਸਾ, ਕਿਰਦਾਰ, ਜਾਂ ਫਿਰ ਖੂਬਸੂਰਤੀ ਭਾਵ ਮੇਰੇ ਵਰਗਾ ਕੋਈ ਦੂਜਾ ਨ ਹੋਵੇ। ਇਸ ਸ਼੍ਰੇਸ਼ਠਤਾ ਨੂੰ ਸਾਬਿਤ ਕਰਨ ਲਈ ਉਹ ਆਪਣੀ ਸਾਰੀ ਵਾਹ ਲਗਾ ਦੇਂਦਾ ਹੈ। ‘ਤੂੰ ਹੀ ਦਸ’ ਕਹਾਣੀ ਵਿਚ ਮਨੁੱਖੀ ਮਨ ਦੀ ਇਸ ਲਾਲਸਾ ਨੂੰ ਬੜੇ ਹੀ ਖੂਬਸੂਰਤ ਅਤੇ ਸੁਭਾਵਿਕ ਢੰਗ ਨਾਲ ਪੇਸ਼ ਕੀਤਾ ਗਿਆ ਹੈ।

ਕਹਾਣੀ ਕੁਝ ਇਸ ਪ੍ਰਕਾਰ ਹੈ- ਗੁਜਰੀ ਪਿੰਡ ਦੀ ਸਭ ਤੋਂ ਸੋਹਣੀ ਕੁੜੀ ਹੈ। ਇਹ ਗਲ ਸਾਰਾ ਪਿੰਡ ਮੰਨਦਾ ਹੈ। ਗੁਜਰੀ ਆਪਣੇ ਪ੍ਰਤੀ ਬਣੀ ਇਸ ਧਾਰਨਾ ਤੋਂ ਨ ਕੇਵਲ ਚੰਗੀ ਤਰਾਂ ਵਾਕਿਫ ਹੈ, ਸਗੋਂ ਇਸ ਧਾਰਨਾ ਨੂੰ ਚੰਗੀ ਤਰਾਂ ਮਾਣ ਵੀ ਰਹੀ ਹੈ। ਉਸ ਦੀ ਖੂਬਸੂਰਤੀ ਵਿਚ ਉਸ ਦੇ ਗੋਰੇ ਰੰਗ ਦਾ ਬਹੁਤ ਵੱਡਾ ਹੱਥ ਹੈ। ਪਿੰਡ ਦੀਆਂ ਔਰਤਾਂ ਨੂੰ ਤਾਂ ਇੰਝ ਲਗਦਾ ਹੈ ਜਿਵੇਂ ਰੱਬ ਨੇ ਉਸ ਨੂੰ ਆਪ ਬਣਾਇਆ ਹੈ। ਦੂਜੇ ਪਾਸੇ ਪਿੰਡ ਦੇ ਮੁੰਡੇ ਇਸ ਗਲ ਦਾ ਦਾਅਵਾ ਕਰਦੇ ਹਨ ਕਿ ਜਦੋਂ ਉਹ ਰੰਗਦਾਰ ਸੌਡੇ ਦੀ ਬੋਤਲ ਪੀਂਦੀ ਹੈ ਤਾਂ ਸੌਡਾ ਉਸ ਦੇ ਸੰਘੋਂ ਹੇਠਾਂ ਉਤਰਦਾ ਦਿਸਦਾ ਹੈ। ਗੁਜਰੀ ਨੂੰ ਆਪਣੀ ਖੂਬਸੂਰਤੀ ਦਾ ਪੂਰਾ ਅਹਿਸਾਸ ਹੈ। ਮੱਸਿਆ ਦੇ ਮੇਲੇ ਵਿਚ ਆਈਆਂ ਵੱਡਿਆਂ ਘਰਾਂ ਦੀਆਂ ਔਰਤਾਂ ਨਾਲ ਮੁਕਾਬਲਾ ਕਰਦੀ ਗੁਜਰੀ ਇਸ ਨਤੀਜੇ ਤੇ ਪਹੁੰਚਦੀ ਹੈ ਕਿ ਉਸ ਵਰਗੀ ਹੋਰ ਕੋਈ ਵੀ ਨਹੀਂ ਹੈ। ਇਸ ਅਹਿਸਾਸ ਨੇ ਉਸ ਨੂੰ ਥੋੜਾ ਅਭਿਮਾਨੀ ਵੀ ਬਣਾ ਦਿਤਾ ਸੀ। ਗੁਜਰੀ ਸਮਝਦੀ ਸੀ ਕਿ ਉਹ ਖੂਬਸੂਰਤੀ ਦੀ ਟੀਸੀ ਤੇ ਹੈ।

ਪਰ ਗੁਜਰੀ ਦਾ ਸਿੰਘਾਸਨ ਉਸ ਵਕਤ ਡੋਲ ਜਾਂਦਾ ਹੈ, ਜਦੋਂ ਉਸ ਦੀ ਗੁਆਂਢਣ ਚਾਚੀ ਚੀਮੀ ਦਾ ਭਣੇਵਾਂ ਸ਼ਹਿਰੋਂ ਛੁਟੀਆਂ ਮਨਾਉਣ ਲਈ ਪਿੰਡ ਆਉਂਦਾ ਹੈ। ਚਾਚੀ ਚੀਮੀ ਸਾਰੇ ਪਿੰਡ ਵਿਚ ਆਪਣੇ ਸੋਹਣੇ ਭਣੇਵੇਂ ਦੀਆਂ ਗਲਾਂ ਕਰਦੀ ਫਿਰਦੀ ਹੈ। ਛੋਟੇ ਹੁੰਦੇ ਤਾਂ ਅੰਗ੍ਰੇਜ਼ ਉਸ ਨੂੰ ਦੇਖ ਕੇ ਆਖਦੇ ਕਿ ਇਹ ਜ਼ਰੂਰ ਕਿਸੇ ਮੇਮ ਦਾ ਬੱਚਾ ਹੋਵੇਗਾ। ਅੰਗ੍ਰੇਜ਼ਾਂ ਵਰਗਾ ਗੋਰਾ ਸੋਹਣਾ ਚਾਚੀ ਚੀਮੀ ਦਾ ਭਣੇਵਾਂ ਸਾਰੇ ਪਿੰਡ ਵਿਚ ਚਰਚਾ ਦਾ ਕੇਂਦਰ ਬਣ ਜਾਂਦਾ ਹੈ। ਪਿੰਡ ਦੀਆਂ ਕੁੜੀਆਂ ਕਹਿੰਦੀਆਂ ਹਨ ਕਿ ਇਹੋ ਜਿਹਾ ਸੋਹਣਾ ਹੋਰ ਕੋਈ ਨਹੀਂ।

ਚੀਮੀ ਦੇ ਭਣੇਵੇਂ ਦੀ ਖੂਬਸੂਰਤੀ ਗੁਜਰੀ ਦੀ ਪਰੇਸ਼ਾਨੀ ਦਾ ਕਾਰਣ ਬਣ ਜਾਂਦੀ ਹੈ। ਉਹ ਨਹੀਂ ਚਾਹੁੰਦੀ ਕਿ ਪਿੰਡ ਵਿਚ ਕੋਈ ਹੋਰ ਉਸ ਤੋਂ ਸੋਹਣਾ ਹੋਵੇ। ਉਂਝ ਪਿੰਡ ਦੇ ਲੋਕ ਵੀ ਕੋਈ ਉਹਨਾਂ ਦੀ ਖੂਬਸੂਰਤੀ ਦਾ ਮੁਕਾਬਲਾ ਨਹੀਂ ਕਰਦੇ। ਪਰ ਗੁਜਰੀ ਨੇ ਆਪਣੇ ਆਪ ਹੀ ਆਪਣੇ ਮੰਨ ਵਿਚ ਇਕ ਮੁਕਾਬਲੇ ਦੀ ਭਾਵਨਾ ਪੈਦਾ ਕਰ ਲਈ। ਉਹ

ਜਾਣਦੀ ਹੈ ਕਿ ਉਸ ਦਾ ਪਿੰਡਾ ਮੁੰਡੇ ਦੇ ਪਿੰਡੇ ਤੋਂ ਕਿਧਰੇ ਸੋਹਣਾ ਹੈ। ਬਸ ਹੁਣ ਉਹ ਮੁੰਡੇ ਦੇ ਸਾਹਮਣੇ ਆਪਣੀ ਖੂਬਸੂਰਤੀ ਪ੍ਰਗਟ ਰੂਪ ਵਿਚ ਦਿਖਾਉਣਾ ਚਾਹੁੰਦੀ ਹੈ। ਤਾਂ ਜੋ ਉਹ ਸਮਝ ਜਾਏ ਕਿ ਉਹ ਗੁਜਰੀ ਤੋਂ ਸੋਹਣਾ ਨਹੀਂ। ਉਹ ਆਪਣਾ ਯਕੀਨ ਵੀ ਪੱਕਾ ਚਾਹੁੰਦੀ ਹੈ, ਤੇ ਨੰਬਰ ਇਕ ਹੋਣ ਦਾ ਅਹਿਸਾਸ ਕਾਇਮ ਰੱਖਣਾ ਚਾਹੁੰਦੀ ਹੈ।

ਇਸ ਇੱਛਾ ਨੂੰ ਪੂਰਾ ਕਰਨ ਲਈ ਉਹ ਆਪ ਮੁੰਡੇ ਨਾਲ ਦੋਸਤੀ ਦੀ ਪਹਿਲ ਕਰਦੀ ਹੈ॥ ਉਸ ਨਾਲ ਆਪਣੀ ਨੇੜਤਾ ਵਧਾਉਣ ਵਿਚ ਉਹ ਸਫਲ ਵੀ ਹੋ ਜਾਂਦੀ ਹੈ।

ਹੁਣ ਉਹ ਦੋਨੋਂ ਕਿੰਨਾ ਕਿੰਨਾ ਚਿਰ ਗਲਾਂ ਕਰਦੇ ਰਹਿੰਦੇ ਹਨ। ਪਰ ਅੰਦਰੋਂ ਗੁਜਰੀ ਆਪਣੇ ਮਤੇ ਦੀ ਪੱਕੀ ਹੈ। ਭਾਵੇਂ ਉਹ ਚੀਮੀ ਦੇ ਭਣੇਵੇਂ ਨਾਲ ਦੋਸਤੀ ਪਾ ਲੈਂਦੀ ਹੈ, ਪਰ ਆਪਣੇ ਆਪ ਨੂੰ ਨੰਬਰ ਇਕ ਸਾਬਿਤ ਕਰਨ ਦੀ ਅੱਗ ਉਸ ਦੇ ਅੰਦਰੋਂ ਨਹੀਂ ਬੁਝਦੀ। ਇਸ ਤਰ੍ਹਾਂ ਲਗਦਾ ਹੈ ਜਿਵੇਂ ਉਸ ਨੇ ਇਹ ਨੇੜਤਾ ਆਪਣਾ ਮੰਤਵ ਪੂਰਾ ਕਰਨ ਲਈ ਬਣਾਈ ਸੀ। ਕਿਉਂਕੀ

‘ਉਹ ਨਿਸਚਾ ਕਰਦੀ ਕਿ ਉਹ ਚੀਮੀ ਦੇ ਭਣੇਵੇਂ ਨੂੰ ਹਾਰ ਦੇ ਕਕੇ ਹੀ ਛੱਡੇਗੀ। ਇਕ ਨਾ ਇਕ ਦਿਨ ਉਹ ਆਪਣਾ ਨੰਗਾ ਪਿੰਡਾ ਉਸ ਦੇ ਨੰਗੇ ਪਿੰਡੇ ਦੇ ਸਾਹਮਣੇ ਖੜਾ ਕਰੇਗੀ ਤੇ ਫਿਰ ਉਹ ਆਪ ਮੰਨੇਗਾ ਕਿ ਗੁਜਰੀ ਉਸ ਨਾਲੋਂ ਵਧੇਰੇ ਗੋਰੀ ਹੈ।

( 3 )

ਅਖੀਰ ਉਹ ਸਮਾਂ ਵੀ ਆ ਜਾਂਦਾ ਹੈ, ਜਦੋਂ ਦੋਹਾਂ ਵਿਚ ਨਜ਼ਦੀਕੀਆਂ ਕੁਝ ਵੱਧ ਜਾਂਦੀਆਂ ਹਨ। ਗੁਜਰੀ ਉਸ ਨੂੰ ਰੋਕਣ ਦੀ ਬਜਾਇ, ਆਪਣੇ ਆਪ ਨੂੰ ਇਸ ਲਈ ਤਿਆਰ ਕਰ ਲੈਂਦੀ ਹੈ ਕਿ ਅੱਜ ਤੇ ਉਹ ਚਾਚੀ ਚੀਮੀ ਦੇ ਅੰਗ੍ਰੇਜ਼ਾਂ ਵਰਗੇ ਗੋਰੇ ਭਣੇਵੇਂ ਨੂੰ ਪੁੱਛੇਗੀ ਕਿ ਸਾਡੇ ਦੋਹਾਂ ਵਿਚ ਭਲਾ ਕੌਣ ਗੋਰਾ ਹੈ ਤੂੰ ਹੀ ਦਸ? ਤੇ ਇਥੇ ਕਹਾਣੀ ਖਤਮ ਹੋ ਜਾਂਦੀ ਹੈ।

ਅਸਲ ਵਿਚ ਗੁਜਰੀ ਇਸ ਸੱਚ ਨਾਲ ਜੀਉਂ ਰਹੀ ਹੁੰਦੀ ਹੈ ਕਿ ਉਹ ਸਭ ਤੋਂ ਸੋਹਣੀ ਹੈ ਪਰ ਚੀਮੀ ਦੇ ਭਣੇਵੇਂ ਦੇ ਆਉਣ ਨਾਲ ਸ਼੍ਰੇਸ਼ਠ ਸੰਦਰੀ ਹੋਣ ਦਾ ਸਿੰਘਾਸਨ ਡੋਲਦਾ ਮਹਿਸੂਸ ਹੁੰਦਾ ਹੈ। ਅਸਲ ਵਿਚ ਇਹ ਸਭ ਗੁਜਰੀ ਦੇ ਦਿਮਾਗ ਦੀ ਹੀ ਉਪਜ ਸੀ। ਪੂਰੀ ਕਹਾਣੀ

ਵਿਚ ਕਿਧਰੇ ਵੀ ਕੋਈ ਅਜਿਹਾ ਹਵਾਲਾ ਨਹੀਂ ਮਿਲਦਾ ਜੋ ਦੋਹਾਂ ਦੀ ਖੂਬਸੂਰਤੀ ਦੀ ਤੁਲਨਾ ਕਰਦਾ ਹੋਵੇ। ਇਹ ਮੁਕਾਬਲਾ ਕੇਵਲ ਗੁਜਰੀ ਦੇ ਦਿਮਾਗ ਦੀ ਹੀ ਉਪਜ ਸੀ।

ਦੂਜੇ ਪਾਸੇ ਅਸੀਂ ਇਹ ਦੇਖਦੇ ਹਾਂ ਕਿ ਮੂੰਡਾ ਗੁਜਰੀ ਦੇ ਮਨੋਭਾਵਾਂ ਤੋਂ ਪੂਰੀ ਤਰ੍ਹਾਂ ਅਨਜਾਣ ਹੈ। ਉਸ ਨੂੰ ਤਾਂ ਇਸ ਗਲ ਦਾ ਪਤਾ ਵੀ ਨਹੀਂ ਕਿ

ਗੁਜਰੀ ਆਪਣੇ ਮਨ ਵਿਚ ਕਿਹੜੇ ਭਾਵ ਲੈ ਕੇ ਉਸ ਨਾਲ ਨਜ਼ਦੀਕੀਆਂ ਵਧਾ ਰਹੀ ਹੈ।

ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ ਆਪਣੀਆਂ ਕਹਾਣੀਆਂ ਵਿਚ ਜਦੋਂ ਮਨੋਵਿਗਿਆਨਕ ਡੂੰਘਾਈਆਂ ਨੂੰ ਪੇਸ਼ ਕਰਦਾ ਹੈ, ਥਾਂ ਮਨੁੱਖੀ ਮਨ ਪਰਤਾਂ ਖੋਲਦਾ ਹੋਇਆ ਉਹ ਮਨੁੱਖ ਦੀਆਂ ਕਮਜ਼ੋਰੀਆਂ ਤੇ ਟੀਕਾ ਟਿੱਪਣੀ ਨਹੀਂ ਕਰਦਾ। ਵਿਰਕ ਬੜੇ ਸਰਲ ਢੰਗ ਨਾਲ ਵੱਡੀਆਂ ਵੱਡੀਆਂ ਉਲਝਣਾਂ ਸੁਲਝਾ ਦੇਂਦਾ ਹੈ। ਇਸ ਕਹਾਣੀ ਵਿਚ ਵੀ ਲੇਖਕ ਕਿਧਰੇ ਵੀ ਉਲਾਰ ਨਹੀਂ ਹੁੰਦਾ।

ਕਹਾਣੀ ਦੀ ਮੁੱਖ ਪਾਤਰ ਗੁਜਰੀ ਆਪਣੇ ਲਈ ਆਪ ਹੀ ਸਮੱਸਿਆਂ ਖੜੀ ਕਰਦੀ ਹੈ ਤੇ ਆਪ ਹੀ ਉਸ ਦਾ ਹਲ ਵੀ ਕੱਢ ਲੈਂਦੀ ਹੈ। ਗੁਜਰੀ ਦੀ ਸੋਚ ਅਤੇ ਉਸ ਦਾ ਲਿਆ ਫੈਸਲਾ ਪਾਠਕ ਨੂੰ ਇਕ ਵਾਰੀ ਹਲੂਣ ਕੇ ਰੱਖ ਦੇਂਦਾ ਜੈ। ਗੁਜਰੀ ਇਹ ਸਾਬਿਤ ਕਰਨ ਲਈ ਕਿ ਉਹ ਸਭ ਤੋਂ ਗੋਰੀ ਅਤੇ ਸੋਹਣੀ ਹੈ, ਸਾਰੀਆਂ ਹੱਦਾਂ ਟੱਪ ਜਾਂਦੀ ਹੈ। ਸਮਾਜ ਵਲੋਂ ਬਣਾਈਆਂ ਸਾਰੀਆਂ ਵਰਜਿਤ ਹੱਦਾਂ ਟੱਪਣ ਨੂੰ ਤਿਆਰ ਹੈ। ਕਿਉਂਕੀ ਉਸ ਨੂੰ ਖੂਬਸੂਰਤੀ ਦੀ ਦੋੜ ਵਿਚ ਅੱਵਲ ਆਉਣਾ ਹੈ। ਇਸ ਲਈ ਉਹ ਕੋਈ ਵੀ ਪੈਂਤੜਾ ਅਖਿਤਿਆਰ ਕਰ ਸਕਦੀ ਹੈ। ਇਹ ਉਸ ਦੇ ਜਨੂੰਨ ਦੀ ਹੱਦ ਹੈ। ਸਾਰੀ ਕਹਾਣੀ ਗੁਜਰੀ ਦੀ ਇਕ ਤਰਫਾ ਸੋਚ ਨਾਲ ਚਲਦੀ ਹੈ। ਕਹਾਣੀਕਾਰ ਨੇ ਐਨੇ ਵੱਡੇ ਮਸਲੇ ਨੂੰ ਚੁਪ ਚੁਪੀਤੇ ਧੀਮੇ ਸੁਰ ਵਿਚ ਹੱਲ ਕਰ ਦਿਤਾ। ਕਿਸੇ ਵੀ ਭਾਵ ਨੂੰ ਵਧਾ ਚੜ੍ਹਾ ਕੇ ਪੇਸ਼ ਨਹੀਂ ਕੀਤਾ।

ਉਂਝ ਤਾਂ ਔਰਤ ਅਤਪਣੇ ਆਪ ਨੂੰ ਸੁੰਦਰ ਦਿਖਾਉਣ ਲਈ ਆਪਣੀ ਪੂਰੀ ਵਾਹ ਲਗਾ ਦੇਂਦੀ ਹੈ, ਪਰ ਕਿਸੇ ਦੇ ਸਾਹਮਣੇ ਆਪਣੀ ਖੂਬਸੂਰਤੀ ਸਿੱਧ ਕਰਨ ਲਈ; ਕਿ ਉਹ ਗੁਜਰੀ ਵਾਂਗ ਸਾਰੀਆਂ ਹੱਦਾਂ ਵੀ ਟੱਪ ਸਕਦੀ ਹੈ? ਗੁਜਰੀ ਦਾ ਇਹ ਫੈਸਲਾ ਸਾਰਿਆਂ ਦੇ ਸਾਹਮਣੇ ਇਕ ਪ੍ਰਸ਼ਨ ਚਿੰਨ੍ਹ ਲਗਾ ਦੇਂਦਾ ਹੈ।

ਇਥੇ ਇਕ ਹੋਰ ਗਲ ਵੀ ਹੈ, ਅੰਗ੍ਰੇਜਾਂ ਨੇ ਦੋ ਸੌ ਸਾਲ ਸਾਡੇ ਉਪਰ ਰਾਜ ਕੀਤਾ । ਅਸੀਂ ਉਹਨਾਂ ਦੇ ਗੁਲਾਮ ਰਹੇ। ਦੋ ਸੌ ਸਾਲ ਦੀ ਗੁਲਾਮੀ ਨਾਲ ਸਾਡੇ ਦਿਮਾਗ ਵਿਚ ਇਹ ਗਲ ਘਰ ਕਰ ਗਈ ਕਿ ਜਿਹੜਾ ਗੋਰਾ ਹੈ ਉਹ ਸਾਡੇ ਨਾਲੋਂ ਸ਼੍ਰੇਸ਼ਠ ਹੈ। ਗੋਰਾ ਰੰਗ ਹੋਣਾ ਵੀ ਸਾਡੇ ਸਮਾਜ ਵਿਚ ਖੂਬਸੂਰਤੀ ਦਾ ਇਕ ਵੱਡਾ ਪੈਮਾਨਾ ਹੈ। ਜਿਸ ਦਾ ਗੋਰਾ ਰੰਗ ਹੈ, ਉਹ

ਆਪਣੇ ਆਪ ਦੂਜਿਆਂ ਨਾਲੋਂ ਉੱਚਾ ਹੋ ਹੋ ਫਿਰਦਾ ਹੈ। ਗੁਜਰੀ ਵੀ ਆਪਣੇ ਆਪ ਨੂੰ ਸਭ ਤੋਂ ਗੋਰਾ ਸਿੱਧ ਕਰਨ ਲਈ ਹਰ ਵਰਜਿਤ ਰੇਖਾ ਟੱਪਣ ਲਈ ਤਿਆਰ ਹੈ।

ਆਮਤੌਰ ਤੇ ਔਰਤ ਆਪਣੀ ਖੂਬਸੂਰਤੀ ਦਾ ਮੁਕਾਬਲਾ ਕਿਸੇ ਦੂਜੀ ਔਰਤ ਨਾਲ ਹੀ ਕਰਦੀ ਹੈ। ਪਰ ਕਹਾਣੀ ਦਾ ਨਿਵੇਕਲਾਪਨ ਇਸੇ ਵਿਚ ਹੈ ਕਿ ਗੁਜਰੀ ਦੀ ਤੜਪ ਦਾ ਕਾਰਨ ਕਿਸੇ ਦੂਜੀ ਔਰਤ ਦੀ ਖੂਬਸੂਰਤੀ ਨਹੀਂ ਸਗੋਂ ਕਿਸੇ ਪੁਰਸ਼ ਦੀ ਖੂਬਸੂਰਤੀ ਉਸ ਲਈ ਵੰਗਾਰ ਜਾਂ ਚੁਣੌਤੀ ਬਣ ਗਈ ਹੈ। ਜਿਸ ਤੋਂ ਉਹ ਕਦੀ ਹਾਰਨਾ ਨਹੀਂ ਚਾਹੁੰਦੀ।

ਸ਼ੋ ਅਸੀਂ ਕਹਿ ਸਕਦੇ ਹਾਂ ਕਿ ਵਿਸ਼ੇ ਦੀ ਚੋਣ ਅਤੇ ਨਿਭਾ ਪਖੋਂ ‘ਤੂੰ ਹੀ ਦਸ’ ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ ਦੀਆਂ ਕਹਾਣੀਆਂ ਵਿਚ ਆਪਣਾ ਇਕ ਵਿਸ਼ੇਸ਼ ਸਥਾਨ ਰਖਦੀ ਹੈ।

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