



# INTERWOVEN

An Interdisciplinary Journal of Navrachana University

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# About Interwoven

Interwoven, Navrachana University's peer reviewed interdisciplinary journal, weaves together a wide range of ideas to offer a layered mosaic of scholarly work. Peer reviewed journals are essential for academic work as they bring new rigor to make corrections and also a completely new perspective to the proposed idea.

Interwoven offers a platform to present scholarly articles that are disciplinary and non-disciplinary, and engage in a rich academic discourse. Non-disciplinary articles, because of their generalistic content provide a means for all readers to find a common ground to connect and get involved regardless of their expertise. Disciplinary work, on the other hand, is presented in a form that non-disciplinary readers can read, understand and participate in an academic discourse to reflect, reinvent and expand traditional disciplinary boundaries.

## Aim and Scope

Interwoven is a double blind peer reviewed interdisciplinary journal of Navrachana University, published online biannually. The journal covers inherently general topics as well as specialized topics written for readers from wide backgrounds. The effort is to build a strong interdisciplinary academic and research culture in the society.

Regarding review process, there is a strong criteria established for an article to be considered for revision, acceptance or rejection. Every article undergoes check for Plagiarism. Each article is reviewed by three referees.

Interwoven has been granted an e-ISSN number (2581-9275). We strongly encourage faculty, scientists, postdoctoral fellows and research scholars to contribute their scholarly work in the form of research articles, review articles, perspectives, critiques, book reviews and articles in social research. We look forward to expand our authors and readers network and set a benchmark in the process of growth for students, faculty, University and the society at large by spreading awareness about various knowledge domains. We also encourage undergraduate and postgraduate students involved in dissertation work to write journal articles and promote new research ideas to expand their vision beyond standard academic curriculum.

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# The Science of how Living Systems Escape Decay to Equilibrium!

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## Abstract

The article discusses how biological systems operate away from equilibrium as open systems, requiring continual input of free energy from the environment to maintain their capacity to do work and self-organize. It also talks about ways in which living cells couple one chemical gradient to another in constructing the many patterns of reactions necessary for life to sustain.

## Key Words

Molecular organization, Non-equilibrium, Entropy, steady state, free energy

## Introduction

Natural selection, (which is largely accepted as the fundamental law in biology) doesn't account for the irreversibility of evolution, complexity generation and self-organizing behavior of living systems<sup>1</sup>. Therefore, attempts have been made to draw connection between physical laws and biological systems. It has been suggested that the 'driving force' behind biological evolution is rooted in the physical principles of Thermodynamics. Certain features that characterizes self-organizing processes involve spontaneous emergence of new functional structures in open systems, operating far from equilibrium and nonlinearly connected through internal feed -back loop<sup>2</sup>. The following article is a brief commentary on how non-equilibrium processes drive and couple free energies of metabolic pathways to create steady-states featuring continual activity and constancy of composition.

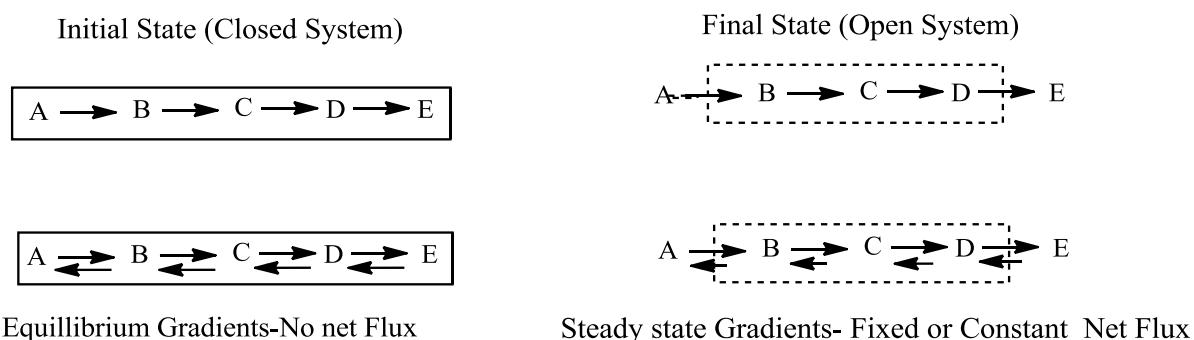
## Open Systems and the Paradox of sustained but stable activity

The discussion starts with a first-hand observation that molecular organization leads to greater order and hence decreased entropy, which apparently seems to defy the second law of Thermodynamics (especially, if we consider an irreversible process in an isolated system). This law gives us a measure of entropy- the thermal energy unavailable to do work, or in other words how many ways molecules be arranged (with or without restriction). The logarithm of the number of ways of arrangement is the entropy. Clearly there are a greater number of ways to arrange them (the term “W” is a measure of that) without restriction than with restriction<sup>3</sup>

[ $S=k_b \ln W$ ],  $k_b$  refers to the Boltzmann constant.

However, biological systems are open systems characterized by fluxes of matter and energy. Order can arise till the entropy of the surrounding system increases enough so that the total entropy from the two parts of the system together increases<sup>4</sup>. But before we embark on the specifics, let us briefly discuss the importance of equilibrium (state of least restriction achieved through degenerate energy states) and non-equilibrium systems (created by more restrictions in the occupancy of energy states, and hence higher level of interaction). All living systems are powered by chemical reactions but chemical reactions have the tendency to destroy gradients and achieve a condition of changeless stability<sup>5</sup>. The question that naturally arise is how then life sustain itself (because work cannot be extracted from a system in equilibrium, wherein free energy change is zero)? Life thus exhibits a fundamental paradox wherein it displays stability and activity (related to work) within the same system. In ordinary chemical systems (where in mass transfer is generally prohibited) stability at equilibrium and changing concentration of reactions are mutually exclusive process; we are allowed to have either activity or stability but not both at the same time. Life processes are therefore in non-equilibrium. Also, life processes are essentially open systems receiving constant inputs of free energy from concentration gradients outside itself. They may go to a steady state rather than an equilibrium<sup>6</sup>. The question then becomes how does a steady state differ from an equilibrium? In an equilibrium process, the concentration gradient falls to zero whereas a constant concentration gradient is maintained in a steady state process and is not zero. The rate of formation and destruction of species (which is regulated by metabolic

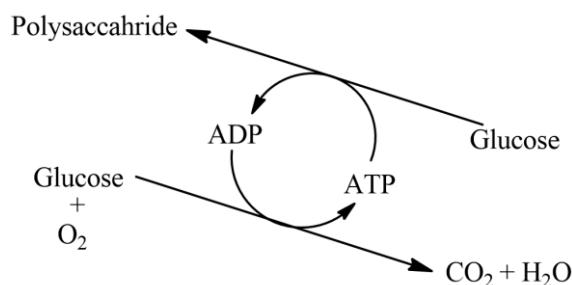
processes outside.) are maintained at a fixed ratio. We may refer to the schematic below (Fig 1) to understand the situation further.



**Figure 1: Difference between equilibrium (left) and Steady state gradients (right)**

For a closed system initially **B**, **C**, **D** and **E** is produced from **A**. As the concentration of **A** decreases and **B**, **C**, **D** and **E** are produced. A reverse reaction becomes operative till equilibrium is attained. There is no change in concentration of the components as the net flux between any of the components are Zero. Contrary to this for an open system, the back reactions don't build up so far or the equilibrium constant values for the back reactions are not same as the forward reactions. This is dictated by the fact that the source (**A**) and sink (**E**) lies outside the rest of the system and their concentrations are maintained constant by factors in the environment. As **A** converts to **B**, some external factor prevents the concentration of **A** from falling and as **D** is converted to **E**, some external factor limits the concentration rise of **E**. **E** is siphoned off as metabolic pathways are interconnected. This creates a concentration gradient and the system achieves a steady state in which concentrations of **B**, **C** and **D** remain constant because there is a constant net flux through the system. (Feedback loop-based systems are ubiquitous to biological systems). The living system is thus an assembly of components, **B**, **C** and **D** forming a link between the source and the sink. They escape tendency to destroy gradients by being an open system by channeling outside energy gradients and living in a steady state rather than settling into an inactivity of equilibrium or in other words an open system achieves stability in steady-state maintaining continuous flow of reactions across a gradient of chemical concentrations<sup>4</sup>. The amount of free energy required to maintain steady-state depends on the extent to which concentration of chemicals are kept removed from equilibrium levels and also the amount of reaction that is allowed to flow across the gradient. In order to maintain the concentration of the species in steady-state,

living systems devised ways to couple one free energy gradient of a reaction to another. Since the quantity of free energy depends on the product of gradient and the amount of charge (matter) flowing across (related to net flux), a large chemical stream with smaller concentration gradient can drive a small chemical stream up a larger gradient, if suitable means can be found to couple one reaction to the other. As an analogy, an electrical step-up transformer can produce a large voltage from a small one provided the current flowing across the high voltage difference is correspondingly smaller than the current across the low-voltage difference. Living cells have developed remarkable means of combining chemical reaction together to utilize free energy of one to drive the other. For example, if aerobic cells (using oxygen) that utilize a powerful downhill reaction ( $\Delta G$  highly negative) of oxidizing substrates such as glucose, is coupled to another reaction that converts glucose to polysaccharides, the cell would still have an overall downhill system, where a small part of the glucose is oxidized and the remaining used for the uphill polysaccharide synthesis. But for reactions to be added, they must be coupled in a material way through a common intermediary component like (ATP, Adenosine triphosphate) which releases the necessary energy (stored in the chemical bonds) to drive the uphill reaction towards the synthesis of polysaccharides (Fig 2). The role of ATP and ADP (Adenosine diphosphate) is similar to a transmission having gears and rods that connects the engine to the wheel.



**Figure 2: Coupling free energy of metabolic processes**

The ultimate gradient is in the environment between the source and the sink and life flows towards the maintenance of this gradient. Life is therefore not the beginning and the end but its maintenance driven by this energy gradient.

Finally, in the words of Fritjof Capra<sup>2</sup> “The more complex the network is, the more complex its pattern of interconnections, the more resilient it will be”.

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# Towards a Sustainable Business in a Changing World

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## Abstract

Fundamental aim of any business is to become successful every year and year after year. We call it Sustainable Business Success or Sustainable Business. Sustainability is dependent on three Ps – People and Planet besides Profit. Business today face an increasing set of challenges like declining market demand, unprecedented competition leading to pressure on both top and bottom line, use of technologies and their negative impact on the society and environment.

Beyond the major focus on profitability, business now conducts community-related activities under the aegis of “Corporate Social Responsibility” (CSR). While such activities help society and create a feel-good factor and a name for the company, in the process, it contributes to business sustainability.

In this context, this paper takes a deep dive at how businesses can sustain for a long time. It defines business sustainability and explore as how it goes beyond what is legislated under Corporate Social Responsibility.

Finally, it identifies a set of critical levers that businesses need to undertake and act upon to ensure their sustainability in a scenario, where change is the “new normal.”

**Key Words:** Business Sustainability, Business Disruption, Agility, Triple Bottom Line

## Introduction

Significant disruption has already impacted the way we do business and disruptions are still going on. Aspirations of the people, economic disparity, scarcity of water/food/energy, climate change, digitalization and unprecedented competition are some of the forces that are reshaping the organizations and hence, their journey towards business sustainability.

The Companies Act, 2013 mandatorily requires corporates to do something extra besides doing business and the same is known as the Corporate Social Responsibility (CSR). While business sustainability encompasses many other aspects of business, CSR or philanthropy contributes positively towards it.

Savitz (2006) explained sustainability as the common ground shared by the business and the public where the profit and common good complement each other. The best-run companies around the world are developing ways of doing business in order to achieve the same<sup>1</sup>.

In simple words, Business Sustainability means business being able to continue indefinitely by minimizing negative environmental and social impacts while ensuring its financial stability. World Council for Economic Development (WCED), 2015, defined sustainable development as something that meets the present needs without compromising the need of the future generations. It addresses issues like economic efficiency, social and environmental accountability<sup>2</sup>.

A sustainable business model is considered as an enduring source of competitive advantage. Examples of media hyped, heavily funded Indian e-commerce organizations closing their shutters or downsizing operations in the recent past owing to the absence of a sustainable business model, are reminiscent of the dotcom bust at the beginning of the 21<sup>st</sup> century, for the same reason. Equally important is the need to adapt business models to changing times. A positive example in this regard is Netflix which commenced operations in the late 1990s with DVD rentals by mail, in keeping with the needs of an increasingly digital age; they transformed their business model to streaming of their products over the internet, which has led to their being a dominant player in the segment.

## Literature Review

Eccles (2012) said sustainable companies follow a two-stage process: first, by reframing company's identity through leadership commitment and external engagement which are closely linked; and second, by building internal support for the new identity through employee engagement and mechanisms for execution<sup>3</sup>. Eccles et al (2014) studied 180 US companies, over an 18-year period, and found that the low sustainability firms followed the traditional model of profit maximization. On the other hand, high sustainability firms are characterized by distinct governance mechanism where the board is directly

involved in sustainability issues. Such firms have a deeper stakeholder engagement, greater non-financial measures regarding employees, greater external environment and social standards, high level of transparency<sup>4</sup>. FICCI-KPMG Report (2014) on “Corporate Sustainability: Drivers and Enablers, India Sustainability Conclave 2014,” said that good companies define, implement, measure and communicate their sustainability strategy that makes good business sense<sup>5</sup>.

KPMG International, Corporate Sustainability-A Progress Report (2011), mentioned that sustainability goes beyond Corporate Social Responsibility (CSR) and it gives opportunities for innovation, competitive advantage and improved bottom-line<sup>6</sup>.

More and more, greater thrust will be required on serving customers better by building long term customer value and sustainable relationships. This would need better network, more openness and more adaptable organization with a focus on fulfilling needs of the customers. This shift would be mainly driven by a high degree of trust that will add to the bottom line.

Bower et al (1995) said that an organization’s sustainability journey starts with managing internal issues like reducing input costs to managing external impacts on business processes as well as risks. As disruptive innovations are impacting the current business models, businesses must engage pro-actively with its external environmental to create new business structures<sup>7</sup>.

Research carried out by PWC (2014) indicates 5 key themes that are very similar to the basic features of future business. These are: (i) serving informed and empowered customers, (ii) creating flexible and adaptive operating models, (iii) drawing on non-traditional resources and partnerships, (iv) adopting a growth & innovating mindset and (v) focusing on accountability, integrity and sustainability<sup>8</sup>. Fauzi et al (2010) proposed the concept of Triple Bottom Line (TBL) postulated by Elkington (1994) as Sustainable Corporate Performance (SCP) covering financial, social and environmental parameters<sup>9,10</sup>. Frederick et al (1992) enumerated two categories of stakeholders - primary stakeholders e.g. investors, suppliers, customers and employees and secondary stakeholders e.g. local communities, business groups, media, social activist group, government bodies<sup>11</sup>.

A useful paradigm to consider while ensuring relevance of business models could be the recently conceptualized “Three Box Solution”, by Govindarajan (2016). In essence, out of these three boxes, Box 1 involves managing the existing business to ensure targeted

profitability through efficient operations. Box 2 involves selective abandonment of existing practices that could inhibit innovation and consequently be a threat to future growth. Finally, Box 3 involves converting breakthrough ideas into new practices and businesses, which is a sound recipe for sustained profitable growth. It is important to note that Boxes 2 and 3 are about the future growth that is both unknown and unknowable, and hence requires planning of a different kind to the one existent for today's successful business. In the context of the Power Sector, Box 3 could refer to the need to create sophisticated power storage solutions, especially on the renewables side, and the need to create solutions for optimal resource utilization, particularly with the growing concerns about water scarcity<sup>12</sup>.

Lowitt (2011) of the Guardian studied a multitude of 2010 Global Fortune 500 Companies on how each one of them are addressing the future issue<sup>13</sup>. Likewise, Newman (2013), Senior Strategist, Enterprise Solution Group, through his conversations with some 20 leaders of Fortune 500 Companies, tried to understand the strategies to achieve sustainability<sup>14</sup>.

## **Methodology**

Literature review and experience of the researchers have been used to carry out this study.

## **Critical Levers for Realizing Sustainability**

One important thing clearly emerges that we need first and foremost to change our mindsets. Sustainability is much beyond Corporate Social Responsibility (CSR) and reduction of cost. Sustainable market leaders view sustainability as an opportunity. Companies need to seek collaboration from the stakeholders.

## **Taking Bull by the Horns**

When the environment is getting more challenging day by day, it is prudent to change before we have to and control our destiny rather than have someone else do the same. In other words, we cannot avoid this truth and thus we must take the bull by the horns.

## **Change Agility**

A popular oft-quoted adage is that the only constant in life is “change.” This holds true for organizations too, more so in a world that is described by the now popular acronym VUCA (Volatile, Uncertain, Complex, Ambiguous). NTPC, India’s largest power generating

company with a 16% share in the country's generating capacity predominantly in the thermal power sector is in the process of revisiting its 2032 business plan and is planning to reach installed capacity of 128 GW with an 11% share contributed through renewables, primarily solar and allocating appropriate capital expenditure to align itself to the environment ministry's mandated new emission and water consumption norms.

**a) Leadership**

Organization culture plays a significant role in leaders to realize the desired results. Bringing in leaders from outside may, however, be necessary in specific situations, particularly when there is a need to bring about radical change and to that extent, a need to look at the problems with a fresh lens and with different perspective. Leadership development is a critical activity for all organizations.

**b) New Technology Adoption**

Technology, at times, can bring in sustainability in business and nullify monopolistic market condition. Prior to 2007, Sub-Critical Thermal Power equipment manufacturing was a monopoly of a Central Government PSU and there was no competition. Once Government selected supercritical technology for inducing higher efficiency and allowed Indian companies to bring in supercritical technology through foreign collaborators, the monopolistic situation came to an end and Thermal Power market became a level playing field since the PSU had also to bring in new technology for supercritical equipment. Since the new technology brought all the companies at par it became a bit easier for others to secure business as well. The technology up gradation journey is continuing.

**c) Digitalization**

While Information Technology is omnipresent for quite some time, Digitalization is coming in a big way in every field and it has immense possibilities. Sensors, Artificial Intelligence, Robotics, Virtual Reality, 3D Printing, Drones, Big Data, Analytics, etc. are few of digital applications, which are making waves. GE developed digital into a business exceeding USD 6 billion in turnover. Robotics has been implemented in manufacturing operations. Analytics can contribute in taking complex decisions, optimizing BOQ, Cost Estimation, Customer Profiling and many other areas. 3D printing in manufacturing segments, as well as

software modeling in 3D, 4D, 5D in the engineering business as well as in the construction space.

***d) Learning Culture/Agility***

The conventional model of organizational learning was the enduring image of executives seated in learning centers and undergoing executive development programs to give them a broad perspective of general management functions, often through case studies of organizations across the globe. While that model has not gone out of relevance, it has been refined – primarily with the aid of technological tools, knowledge management systems as well as through interventions like job rotations, overseas deputations, stretch assignments – to ensure that the learning is more of a blended nature and executives are periodically made to step out of their comfort zones to handle work of different natures and therefore have the onus to continuously learn and stay relevant. It is also important to note that with the growing cognizance of the need for constantly innovating, organizations will need to experiment and take risks at greater frequencies and therefore, make allowances for failures. Hence, it is important to create a culture of learning from failures. Further, every interaction – whether formal business reviews, performance conversations or meetings with customers, suppliers, government officials or special interest groups – needs to be seen as opportunity to add to one's learning in order to cement that learning culture. Finally, it is important to leverage diversity (an important thrust area in many organizations) of employee backgrounds, ideas, perspectives, experiences and competencies in order to enrich learning and gather newer insights.

***e) Organizational Design***

In fast changing economic scenarios owing to factors pertaining to the macroeconomic and political realms, organizations are required to revisit their business strategies at greater frequencies as compared to yesteryears. As a key building block of organization strategy, with the increase in environmental complexities, organizations must aim to be agile, nimble and quick footed. If right sizing/downsizing is the need of the day, it shall be embraced since it will ensure better conditions for a large number of people for a long time.

**f) Ethics, Corporate Governance, CSR**

It is important to have an unshakeable core in the form of a value system. It is essential to remain true to a multi-pronged value of caring, customer focus, corporate social responsibility (CSR), integrity, ethics, corporate governance and operational excellence. These factors help to develop a deep-rooted connect with all stakeholders including customers, employees, society, government bodies and others. It is vital for organizations to develop a robust framework for corporate governance. In this regard, while norms (E.g. Companies Act, 2013 in the Indian context) have been framed to make boards more diverse, whether in the form of greater proportion of independent directors or mandatory inclusion of women directors, their adherence remains a concern.

**Conclusion**

Business today is confronted with an increasing set of challenges, in an LPG (Liberalization, Privatization, and Globalization) era as compared to previous decades. Thus, business-as-usual approach will be inadequate to meet the present situation. These challenges, if not dealt with properly, would be a threat to the sustainability of any organization, irrespective of their present level of stability and maturity.

As a starting point to confront these challenges, an organization must target to achieve “Triple Bottom Line,” in letter and spirit. This concept encompasses business profitability as well as the relatively newer concerns related to society and environment. Critical levers, as enumerated earlier in the study, can help business to realize sustainability. Support from top leadership is a must to achieve this goal. Sustainability needs to be embedded in the core business strategy. It needs to be cascaded down to operating level.

Future business must have the ability to see a changing external environment as a source of opportunity rather than risk. It will make the business more resilient in adapting to the changes.

The emerging themes on the sustainable business are integration of sustainability into core business functions, increased business transparency, networking, climate change, seamlessly integrated functions, focused planning processes, prioritizing value over volumes, superior risk management and providing platforms for innovation.

Finally, companies would need to develop innovative business models to drive rapid growth and make everyone accountable for growth with core values of integrity, sustainability and social impact.

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# Evaluation of Literature Search Strategy amongst Dental Faculty of K.M. Shah Dental College – A Questionnaire Based Study

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## Abstract

Continuing professional development is of vital importance for the academicians teaching in educational institutions to keep themselves abreast with the recent happenings in the scientific world. The literature search strategy forms the basis of professional growth and development. To locate sound evidence a well-structured literature search is important which may be found in books, journals, government documents and on the internet. Hence this research attempts to evaluate the Literature search strategy for best evidence among the dental faculty of K.M. Shah Dental College by questionnaire tool. Pre-validated questionnaire was used among the teaching faculty from the K.M. Shah Dental College. Out of total 70 faculty who participated in this study 60% to 80% of respondents used Google, Google-Scholar and PubMed regularly for their literature search. Majority of participants (90.14%) used to define search question before starting the search. Around 70% of the participants formed PICO for their search strategy. Majority of participants were aware of Keywords,

Filters, MeSH term, Boolean operators and advanced search options and felt that it gives more precise and specific search results. Basic knowledge of research and how to search for literature is adequate among the health professional but implementation of basic search strategy is required to practice an evidence-based dentistry. It is recommended to train the entire health professionals for searching and using database for procuring the best available evidence.

**Key Words:** Medical Subject Headings, Literature Search, Evidence-Based Dentistry, PubMed, Publications

## **Introduction**

A literature search is a methodical and systematized search for all of the literature published on a subject. A well-structured literature search is the most effective and efficient way to locate sound evidence on the subject you are researching which may be found in books, journals, government documents and on the internet<sup>1</sup>.

In our daily clinical settings, we come across various clinical conditions or scenarios that mandates the precise evidence based treatment option<sup>2</sup>. Asking and answering clinical questions during daily practice can be challenging and time consuming. Knowing the resources available to answer a specific clinical question can lead to a more efficient and effective search strategy and thus, to a more applicable answer based on the levels of evidence available<sup>3,4</sup>.

Creating a well-focused question is the first step – this will help you determine useful keywords and limitations for your topic. Having defined the search topic and identified the key concepts, you need to produce a list of keywords that will be used as your search terms when you begin your search. The keywords should consist of all possible words or phrases that might be used to describe the subject. Various previous studies found PubMed database to be superior to find out the best evidences near to the gold standard<sup>5</sup>.

The proper and precise Literature search strategy is a very important step towards right evidence on the topic. Hence this research attempts to evaluate the Literature search strategy for best evidence among the dental faculty of K.M. Shah Dental College, Sumandep Vidyapeeth by a questionnaire tool. The objectives of the research were to evaluate

knowledge of literature search strategy amongst Dental Faculty, evaluate orientation of literature search strategy amongst Dental Faculty and compare the change in Literature search strategy after giving the search blue print.

## **Methodology**

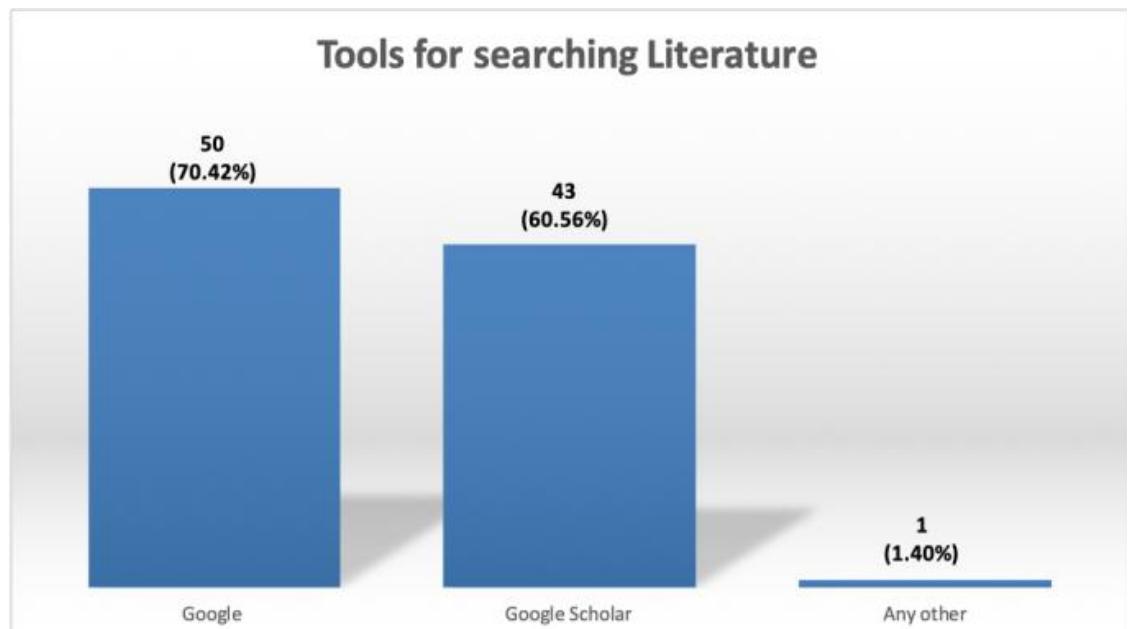
The Questionnaire study was carried out after approval from ethical committee of Sumandeep Vidyapeeth. All the teaching faculty from the K.M. Shah Dental College, Sumandeep Vidyapeeth who were willing to participate in the study were surveyed for their knowledge regarding the Literature Search strategy.

The questionnaire was first administered to 10 experts and 15 respondents for validation. As mean values of experts and respondents didn't differ significantly for knowledge and orientation scales, it was concluded that the knowledge and orientation scale was validated ( $p\text{-value} > 0.05$ ). The overall reliability of the questionnaire was about 92% (Cronbach's Alpha = 0.917).

The Prevalidated questionnaire was then distributed among the selected teaching faculty of the institute after the due informed consents were obtained. The filled questionnaire was then collected and the data from it was compiled for further statistical analysis.

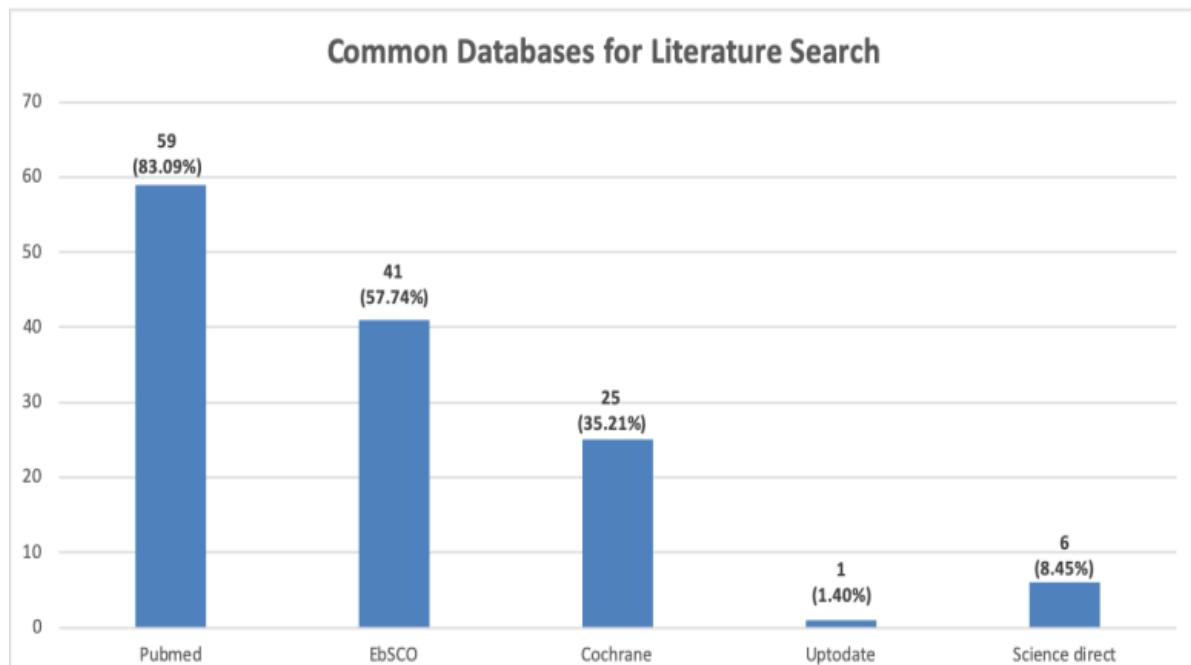
## **Results and Observations**

Total sample size for the study was 70. Faculty were asked different types of closed and open ended questions with few of the questions in 'Yes-No' answers. When the faculty were asked regarding the tools for literature search 60% to 70% of respondents used Google and Google-Scholar regularly for their literature search Figure 1.



**Figure 1: Tools for Searching Literature**

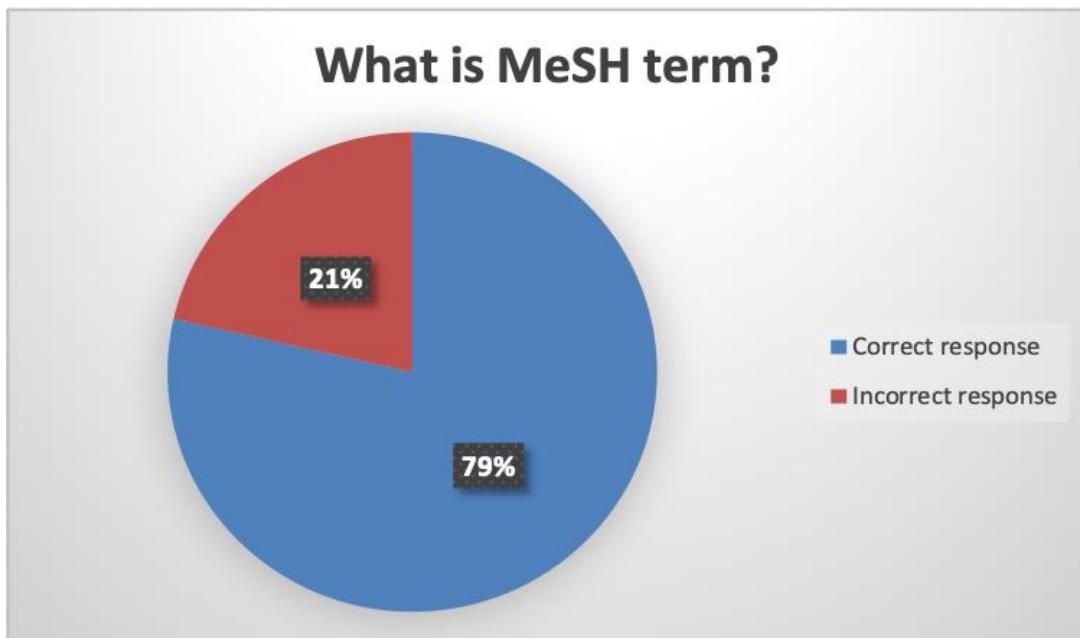
The most common database used to search was PubMed which was 83.09%. The graphical presentation of various databases searched by faculty is presented in Figure 2.



**Figure 2 : Common Databases for Literature Search**

Majority of participants (90.14%) used to define search question before starting the search. Around 70% of the participants formed PICO for their search strategy. Most of the

participants opined to the open ended question related to importance of keywords in search. The participants felt that the keywords reduce the volume of literature specific to PICO and helps in limiting the search in focused way. Keywords also helps in limiting the search data and getting the relevant search articles. 77.46 % participants were aware about **MeSH** term Figure 3.



**Figure 3 : MeSH Term**

More than 50% of the participants used **MeSH** term. Around 65% of the participants used **Booleans** like AND, AND OR NOT, AND BOTH, AND OR. The participants felt that the **filters** help in narrowing down the search making the outcome more research question specific and helps in avoiding unwanted and irrelevant data. The participants commonly used article type, availability of full text, language, type of study, year of study, human study, free full text, etc as **filters**. The participants felt that PubMed is the most user-friendly database **search engine** followed by Google and Google scholar along with various other search engines such as EBSCO, DOAJ, Medline etc. The results also showed that 53.52% of participants sometime use advanced search options while 33.8% rarely use advanced search options Figure 4.

**Figure 4 : Advance Search Options**

Majority of participants were aware of advanced search options and felt that it gives more precise and specific search results. (Table 1 & Table 2)

Question	Yes	No	If Yes
Do you define your search question before starting your search	64 (90.14%)	6 (8.45%)	NA
Do you form a PICO for your search.	49 (69.01%)	21 (29.57%)	NA
Do you use MeSH term	38 (53.52%)	31 (43.66%)	NA
Do you use Boolean and which Boolean you use first	46 (64.78%)	24 (33.80%)	AND 25 AND OR NOT 15 AND BOTH 1 AND OR 1

**Table 1: Closed-Ended Survey Questions**

<b>Importance of keywords in search</b>	<b>What do you mean by filter</b>	<b>Which are the commonly used filters for your research ?</b>	<b>When do you use filters in the search process</b>	<b>How advanced search is different from search?</b>
<p>“volume of literature specific to PICO.”</p> <p>“the best article directly related to the PICO question”</p> <p>“limits results shown for needed data, saves time”</p> <p>“simplify search”</p> <p>“focused results”</p> <p>“easy”</p> <p>“appropriate results”</p> <p>“define the search”</p> <p>“refined search”</p> <p>“limits searching data”</p> <p>“getting relevant search articles”</p>	<p>“narrowing the search”</p> <p>“limit search”</p> <p>“precise results”</p> <p>“avoid irrelevant data”</p> <p>“used to refine search”</p>	<p>“article type”</p> <p>“language”</p> <p>“type of study”</p> <p>“text availability”</p> <p>“publication dates”</p> <p>“year of study”</p>	<p>“remove unwanted data”</p> <p>“specify the search”</p> <p>“narrow search results”</p> <p>“refine the search”</p>	<p>“search specific to the author, journal type, publication year etc.”</p> <p>“limits search”</p> <p>“more precise”</p>

**Table 2: Content Analysis of Open-Ended Survey Questions**

## Discussion

Good efficient searching comprises of systematic stepwise approach to help the researcher from the research question to informed evidence-based decision making. Literature search plays a very vital role in good quality research.

The results of our research demonstrated that the participants in the research were well aware of the literature search strategy and procedures. This might be due to regular training and refresher courses being conducted for the staff of the institution on evidence-based dentistry and evidence based decision making.

Grewal et al. (2016) had explained different methods of literature such as primary literature, secondary literature and tertiary literature<sup>6</sup>. They have also mentioned various search engines such as Google, Google Scholar and Yahoo. In our research around 60 to 70% of participants used Google and Google scholar as search engines. They have also highlighted various electronic sources of research database such as PubMed, Medline, SCOPUS, ProQuest. Almost 60 to 84% of the respondents were using databases such as PubMed, Google Scholar their regular literature search. As evident from our research various databases such as EbSCO, Cochrane, Up-to-Date and ScienceDirect where frequently used by the researchers for a literature search.

It is very important to construct the well-defined and appropriate research question<sup>1</sup>. A properly designed research question should address several components in the form of PICO, where P stands for patient population, I for intervention, C for comparative intervention and O for outcome of interest<sup>7</sup>. It is imperative to address all the components of PICO to arrive at well-defined research question. Well defined research question plays a very important role in driving the keywords for literature search<sup>7</sup>. In our research more than 90% of the participants define their research question before starting the literature search and around 70% of participants from well-defined PICO for literature search question. The participants in our research were using different types of keywords regularly and were of opinion that keywords reduces the volume of search specific to PICO and helps in retrieving the best article directly related to PICO question. They opined that keywords limits the results shown and hence simplifies the search focuses the results and saves the time in searching the relevant data.

A classic example of a thesaurus is Medical Subject Headings also called as MeSH. It is used in the Medline (PubMed) database. Each article in the Medline database is allocated ten to twenty words in the MeSH index to define each article's content. The use of MeSH topic search terms gives greater control and accuracy<sup>8</sup>. In our research more than 75% of participants were aware of MeSH and more than 50% of participants regularly used MeSH terms. This is reflection of how well-verses they are regarding use of specific medical subject headings during literature search.

Boolean operators are used during literature search to combine concepts or create relationships. The three Boolean operators commonly used are AND, OR and NOT. They are used to broaden or narrow the results. Parentheses may also be used for more complex

Boolean searches. In the present research around 65% of the participants used Boolean operators and ‘AND’ was the most commonly used Boolean operator.

The filters are usually used to refine the search results. Various filters commonly used are type of article, language, text availability etc<sup>6</sup>. Waltho, D et al. (2015) systematically explained the steps to perform a literature search<sup>7</sup>. They have emphasized on implementing filters to narrow down a search. Various search engines have different types of inbuilt tools to limit the outcome of search. These tools are termed as filters. In our research the respondents were well aware of using different types of filters. They felt that the filters helps in narrowing down the search making search results more research question specific and helps in limiting the results, avoiding irrelevant data and giving more precise outcome. They mentioned some of the common filters used by them such as article type, availability of full text, language, type of study and year of study. Along with filters more than 50% of the respondents in our research had used advanced search options during their literature search. The participants responded that the advanced search helps in getting more specific and precise search results related to the area of interest and helps in retrieving clearly focused data.

## Conclusion

In this Era of information overload it is very important for a researcher to know and implement the correct literature search strategies. Literature search requires a combination of skills and knowledge about strategies involved, different databases, tools and filters available along with systematic step wise implementation. This research has clearly shown that the participants involved in this research are well aware of different aspects of literature search strategy and can use this knowledge in evidence-based decision making.

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# A Study of the Awareness, Attitude and Proposed Actions of Secondary School Students toward Environmental Issues

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## Abstract

The world today is witnessing several environmental crises – an outcome of insensitive exploitation of natural resources by man. There is an urgent need for sensitization so as to protect, conserve and nurture these resources. The objective of Education for Sustainable Development is to empower all people of the world to endeavor for a sustainable future.<sup>1</sup> Education directly imparts responsibility because an educated citizenry is vital to take informed decisions and actions. Development options, especially, the “greener” ones expand as education improves. Thus, Education is central to improving quality of life. The National Curriculum Framework recommended that Environmental Education should be taught in the Upper Primary/Secondary levels in school to create awareness.<sup>2</sup>

The present Study was conducted to assess the environmental awareness and attitude among the secondary school students who would be the future citizens of the world. The major findings revealed that there was a significant level of awareness and a positive attitude towards sustainable development among the secondary school students. However, while the present approach to environmental education is interdisciplinary, drawing from biological, sociological, economic, political and other humanistic sources, students could be made better aware if proper guidance and counseling are given about environment via a well-structured awareness program. To conclude, it is necessary to augment our efforts in the campaign for environmental education.

**Key words:** environmental education, environmental awareness, sustainable development, secondary school students

## Introduction

The world has been facing a multitude of environment crises – an outcome of the insensitive and reckless exploitation of natural resources by man. The latest is the devastation of COVID 19 virus across the world that has already affected more than 10million people with more than 500,000 deaths till date. These numbers could be even scarier after a month or two. Environment has been worst affected over the years due to misdeeds of human being. The impact of greenhouse gases like Carbon Dioxide is depleting the Ozone layer that protects earth from harmful Ultra-Violet (UV) rays. It is also inducing Global Warming that has adverse impact on Climate Change. The immediate requirement is drastic reduction of carbon footprint in the world which, in turn, would require significant reduction in the use of fossil fuels. The historic Paris Agreement 2016 is case in point.<sup>3</sup> Under the banner of United Nations Framework Convention on Climate Change (UNFCCC),195 nations came together and agreed to take certain definite actions to fight this menace to limit global warming to 1.5 Deg C in this century. Sustainable Development has become the only way forward for the world to survive. It means that we need to keep this world habitable for our future generations as we inherited this earth from our past generations. Thus, there is an urgent need for sensitization of the people so as to protect, conserve and nurture the natural resources. Education for Sustainable Development (ESD) Education 2030 proposed by UNESCO (2015, 2017, 2019)<sup>1, 4, 5, 6</sup> urges people to think and work towards a sustainable future for the world. ESD has a crucial role to play in building social and individual capabilities and attitudes towards finding solutions for climate change. Quality education is a critical tool at all levels for sustainable development. It can help people to develop knowledge, skills, values and behaviors needed for sustainable development. Education directly affects sustainability as an educated society can take informed decisions, implementation and actions. It can lead to "greener" development.

### **Creating Environment awareness through education**

Sustainable development refers to economic development that is achieved without depletion of natural resources. Education is crucial for the present as well as future citizens to create solutions for a better future. Education for Sustainable Development (ESD) is a set of various forms of education – both the existing ones and the new ones that remain to be created. Sustainability requires a population that has the knowledge and understanding of this crucial

issue to achieve the above goals. It needs to be done across all levels in the formal education system.

### **Environmental Sustainability – The Indian perspective**

Environmental protection is the responsibility of the respective states as given in the Indian Constitution. It is not only the state governments; every citizen must be responsible and accountable for it.

The Honorable Supreme Court of India in 1991 made environmental education compulsory at all levels of education. A curriculum framework prepared by the NCERT was accepted by the Court as the guideline for State Education Departments to develop textbooks for schools from 2004-2005 onward.

The National Policy on Education 1986<sup>7</sup> (modified in 1992) observed the importance of awareness for the environment in all people.

### **Rationale**

Though, there is sufficient literature available on environment education in India, it is important to assess the ground reality i.e. to understand the impact of Environmental Education strategies at school level. The present approach to environmental education is interdisciplinary, drawing from biology, sociology, economics and many other disciplines, but the researchers believe that students' awareness about environment can be made better if proper guidance is given through a well-structured program. Developing understanding and knowledge about the environment in secondary school students can change their behavior and attitudes as well as bring about sensitization leading to positive thoughts and actions towards solving their local environmental problems. For the reason explained above, a Study was undertaken to assess the awareness, attitudes and actions to be taken, for Std X students of a Senior Secondary school in Vadodara, for environmental sustainability.

### **Ethics**

Due consent was obtained from the respondents and complete anonymity was maintained in conducting the Study.

## **Sample of the Study**

All the Std X students (total 100) of Sections A, B and C of a Senior Secondary School in Vadodara were taken as sample, purposively and were explained the objective of the Study. Responses were collected on their awareness, attitude and actions to be taken, to ensure environment sustainability.

## **Tool employed**

The research was carried out using a questionnaire as data collection instrument. The questionnaire consisted of 3 sections: “Awareness”, “Attitude” and “Action”. The instrument developed in this Study consisted of a questionnaire using a 4-Point Likert -type response scale and Agree/Disagree response items. The tool included both open and close ended questions to elicit information related to environmental concerns. The tool was validated by the experts of education discipline.

## **Analysis**

Quantitative Analysis – The responses received were then tabulated into a Microsoft Excel Sheet and the scores were analyzed to determine the percentage of students in each category via percentage analysis.

## **Findings**

The survey was conducted to assess students' awareness and attitude to sustainable development. Major findings revealed that there was a significant level of awareness and a positive attitude towards sustainability among secondary school students, as given below:

### **Awareness**

- a) 53% of students were aware of the concern regarding Environmental Sustainability;
- b) 55% understand the meaning of the term ‘Sustainability’;
- c) 66% responded that carbon footprint means the amount of CO<sub>2</sub> released into the atmosphere as a result of human activities;
- d) 51% students responded that the current state of the world's ecosystem services was average.
- e) 66% of students understood the importance of renewable/non-renewable resources;
- f) 83% informed that sustainable development was being taught via the school subjects.

## Attitude

- 1) 55% of students make effort to be knowledgeable about sustainability;
- 2) 60% students strongly agree that it is their responsibility to make a difference with respect to environmental issues;
- 3) 45% are strongly concerned about sustainable development;
- 4) 74% students were in favor of Energy conservation practices;
- 5) 48% of students supported Recycling of solid waste;
- 6) 43% supported Sustainable transportation programs;
- 7) 63% supported water conservation practices;
- 8) 33% students supported the use of environment-friendly products;
- 9) 72% supported measures to minimize carbon emission due to transportation;
- 10) 59% of students supported the use of reusable products.

## Actions Proposed

Students suggested the following to bring change and ensure environmental sustainability:

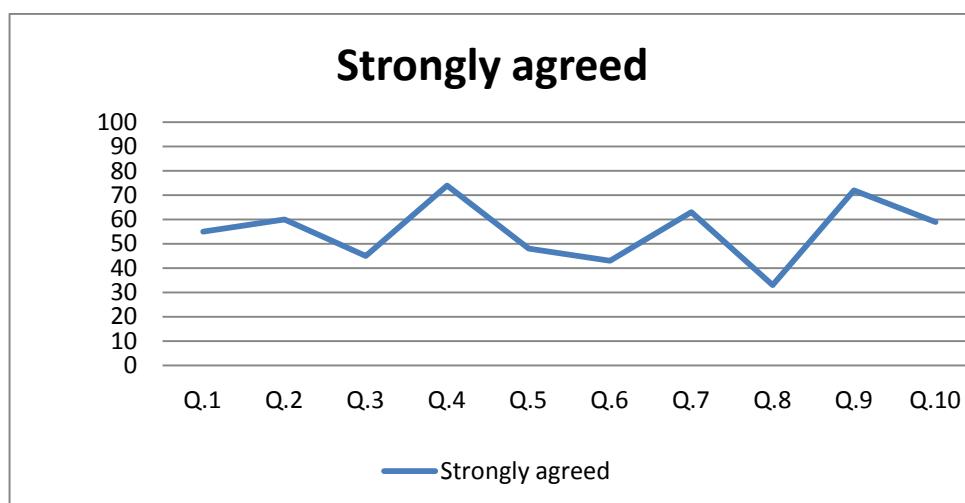
1. Spreading awareness amongst students to ensure environmental sustainability;
2. Prudent use of resources;
3. Minimizing wastage;
4. Adopting Carpooling; Using of public transport;
5. Avoiding the burning of waste in the open;
6. Using of solar / other renewable sources of energy;
7. Supporting planting trees (afforestation);
8. Installing rainwater harvesting system;
9. Segregating degradable / biodegradable wastes;
10. Substitute the use of plastic with environment friendly products;
11. Adopting the philosophy of 5Rs – Reduce, Recycle, Reuse, Refuse & Regenerate
12. Educating the masses via a Best out of waste management program.

## Implication of the findings

2005-2014 was declared as the UN decade of Education for Sustainable Development. The goal was to create a more sustainable future for the world. Amongst various ways to

sustainability, education is an important one. Agenda 21<sup>8</sup> is an action plan of the United Nations with regard to sustainable development discussed in United Nations Conference on Environment & Development Rio de Janeiro, Brazil, 3 to 14 June 1992. The "21" in Agenda 21 refers to the original target year of 2021 to achieve their development goals. It has been subsequently revised to a new time line of 2030.

Education is the primary agent for transformation towards sustainable development. Education augments people's potentials and capacities; it provides not only the requisite scientific and technical skills, but also the understanding for their judicious application. Education is essential for mobilizing minds and communities in the endeavor for sustainable development. It is for this reason that society must be deeply concerned both with the access to education as also the quality of education imparted. Education for sustainable development aims at future, ecology and social well-being of all people.



**Figure 1: Student Attitude about environment sustainability**

The major findings of this Study indicated that while there was awareness about environment sustainability and a positive attitude too, we would be required to step up our efforts as can be seen from the figure above where the responses were positive but could definitely be enhanced. It is necessary to augment our efforts in the campaign for environmental education.

School education must contribute to increased sensitivity to this concern via the designing of curricular events - Organize excursions and field trips, develop enquiry-based projects, as also "improve the capacity of our education systems to prepare people to pursue Sustainable development" (United Nations, 2012: Para 230<sup>9</sup>). We must devise more support for teachers via flexibility in curriculum policy that allows primary and secondary schools to develop content

and projects that are locally relevant as also support the Education for Sustainable Development.

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# The impact of Mid Day Meal in government elementary schools of Surendranagar city

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## Abstract

Mid Day Meal (MDM) has been an important part of education from decades as Government of India (GOI) gradually put efforts to improve quality and quantity of food. The present study focuses on the physical growth of students in terms of their age, height and weight along with the number of days the students had MDM intake in schools. The data were analyzed by calculating frequency and percentage. The data collected through information schedule of students to collect data of height, weight and number of days the students had MDM in school. The findings of the study reveal that majority of students have age appropriate height and weight with majority of students had MDM intake for more than 220 days. It indicates that MDM had been one of the important aspects of physical growth of students.

**Key words:** Mid day meal (MDM), health, physical growth, elementary school students

## Introduction

Health at an early age of childhood is critical aspect which has direct relation with the food taken in daily life. Proper food and nutrition support gives assistance to physical as well as mental health which has been taken into consideration long back by Government of India (GOI). Education is one of the areas where initiative in terms of providing food has been taken by GOI. GOI has long history in providing food to school going disadvantaged section of children for proper nutrition intake for combating hunger and improving health which is currently known as Mid Day Meal (MDM). Its beneficiaries are children belonging to age group of 6 to 14 years.

## **History of Mid Day Meal in India**

Mid day meal has history from 1925 when it was first started in Madras Corporation by British administration in pre independence era which was introduced later by Government of India in 1995 as National Programme of Nutritional Support to Primary Education (NP-NSPE). With the inception of Sarva Shiksha Abhiyan (SSA), Mid Day Meal (MDM) was emphasized gradually as MDM merged under SSA to improve quality education in elementary school to achieve the goal of Universalization of Elementary Education (UEE). In 2001, cooked mid day meal scheme under which students were provided food with minimum 300 calories and 8 to 12 gram protein per day for minimum 200 days in government and government aided schools. In 2002, it was made available for students studying in Education Guarantee Scheme (EGS) and Alternative & Innovative Education (AIE) centers also. Mid day meal had been revised in the year 2004, 2006, 2007 and 2008 finally when it was made available for all students in elementary education up to 14 years of age, including recognized Madarasa also, supported under SSA. MDM from 1925 to 2008 establishes the fact of its effectiveness in terms of providing nutritious food to children for improving enrolment, attendance and retention along with improving nutrition status among children. There was provision of providing capacity building for MDM in terms of infrastructure facility and manpower. Under the norms of SSA for MDM, separate kitchen was built providing one supervisor and two cooks for cooking food as per the menu provided. Initiatives for implementation of MDM was taken at state, district and block level by providing man power and funds. As the scheme of MDM was revised, guidelines also were revised over period of time after SSA for allocation of funds and food grains.

## **Significance of the MDM**

Objective of MDM was to provide nutritious food to students so that their attentiveness in the classroom increases and also to improve school enrolment and attendance along with decrease in dropout rates. “After the introduction of mid-day meals the percentage of enrolment has increased and parents are more interested to send their children”<sup>1</sup>. MDM also had been seen as potential incentive to attract students to school providing them some kind of food regularly in the school. “Mid-day meal scheme is successfully serving the purpose for which it was started. It has brought an increase in attendance rate of children”<sup>2</sup>. It

is evident that MDM is helpful in bringing students to classroom but the question is whether it has impact on nutrition level of students. An improvement in the nutrition level of the students was found along with attendance and scholastic performance as stated "...after the introduction of the MDM program it was found that nutritional status of children improved"<sup>3</sup>. At the same time it was found, "The contribution of micronutrients through mid day meal programme was negligible..."<sup>4</sup>. It becomes important to see the impact of MDM on students in terms of physical growth as MDM is meant to provide nutrition food to students which ultimately should have positive effect on the health of students. Physical growth is prerequisite to health of students as "The precondition for all development is healthy physical growth of all children" and further stated, "It is proposed that the midday meal programme and medical check-ups be made a part of the curriculum and education about health be provided that address the age specific concerns at different stages of development"<sup>5</sup>. As observed earlier, government had a long history of MDM in different ways with great financial efforts too; it necessitates glancing at grass root level how the MDM has affected the students especially in terms of health. The present research has aimed to study the impact of MDM in terms of physical growth on students who had MDM on regular basis as MDM is provided in school for minimum 200 days. Physical growth of students was particularly studied in terms of height and weight of students separately for girls and boys as per the Body Mass Index (BMI) released by World Health Organization (WHO). BMI gives an idea about weight as per height by some measurements. BMI is a standard calculation to analyze health status by categorizing the students in a particular weight group. BMI categories as per calculations of height and weight are presented in following Table 1.

BMI	Nutritional status
Less than the 5 <sup>th</sup> percentile	Underweight
5th percentile to less than the 85 <sup>th</sup> percentile	Normal weight
85 <sup>th</sup> to less than the 95 <sup>th</sup> percentile	Overweight
Equal to or greater than the 95 <sup>th</sup> percentile	Obesity

(Source: WHO, BMI - 2019)

**Table 1: BMI categories as per calculations**

### **Significance of MDM in Surendranagar**

The literacy rate of Gujarat as per census 2011 is 79.31%. Among the regions of Gujarat state the literacy rate varies from 85.53% in Surat to 58.82% in Dahod. Surendranagar has literacy rate of 72.13%. Surendranagar is one district having low literacy rate. The Surendranagar is part of Saurashtra region of Gujarat. Surendranagar had enrolment rate of 88.10% in lower primary and 82.81 % in upper primary. Surendranagar had lowest enrolment rate among the municipalities of Saurashtra in spite of several efforts of government to improve education by different initiatives. Hence, Surendranagar becomes important site to examine that how the government initiatives have an impact on the students of Surendranagar with special reference to MDM. The students who have almost completed their elementary school from government schools are the ones who have been in school for at least seven years. These students have had MDM in school for at least seven years as one time meal. It is significant to find out impact of MDM on physical growth (Height and Weight) of students who have taken MDM as one time meal. It is also one of the objectives of MDM.

### **Methodology**

Method adopted for the present study is survey. There were 490 students of class VIII of academic year 2017-18 from 22 government elementary schools of Surendranagar city of Gujarat, who had studied from class I to class VIII without dropping out in same school were taken as sample. The objective was to study the days of MDM intake by students and to find the impact of MDM on the health of students especially in terms of physical growth (Height and Weight as per age). The information regarding age and gender has been collected from general register maintained by school. The number of students attended the school has been recorded in general register of school which shows number of days the students had MDM in school. So, the information regarding number of days students having MDM in school has been collected from general register of attendance maintained by class teacher. The information regarding height and weight of students has been measured personally by researcher and recorded. The height of students has been recorded in measurement of centimetre and weight has been recorded in kilogram. Data regarding the number of days the students had MDM were collected only of one academic year of 2017-18 in which students

were in class VIII. The data collected from the information schedule were numeric. Observing the highest and lowest numbers in each item, equal class intervals were made and frequencies were distributed across each category of variables. Height and weight of the students were calculated as per BMI calculations and presented. The data were analyzed using calculating frequency and percentage.

### **Data analysis**

The data received from 22 government elementary school is analyzed in terms of numbers of days the students had MDM in school and growth of students in terms of height and weight are presented in tabular form. The number of students had MDM during academic year 2017-18 are presented and described below:

Gender	Percent of days the students had MDM (2017-18)			N
	<u>≤ 200</u>	<b>201-220</b>	<u>≥221</u>	
<b>Boys</b>	11.69 %	32.66 %	55.65 %	100 %
<b>Girls</b>	8.68 %	23.97 %	67.35 %	100 %
<b>Total</b>	10.20 %	28.37 %	63.27 %	100 %

**Table 2: MDM intake of students in percent (%)**

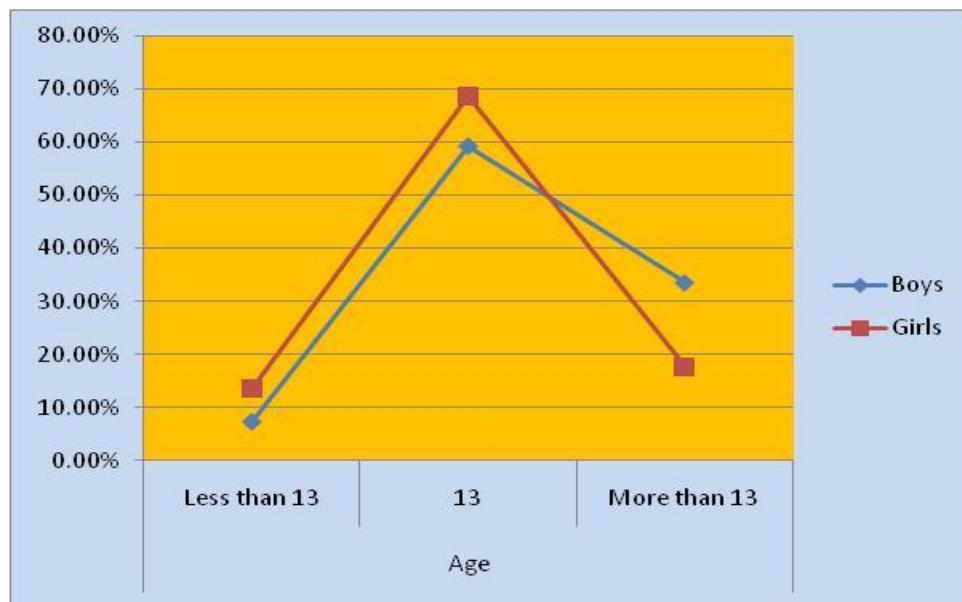
Out of total number of students, 248 are boys and 242 are girls. It is observed from Table 2 that majority of boys had MDM for more than 200 days. Among these students, 32.66% of boys had MDM for between 201 and 220 days whereas 55.65% of boys had MDM for more than 220 days. Few boys (11.69%) have had MDM for up to 200 days or less. Majority of girls (67.35%) had MDM for more than 221 days and 23.97% of girls had MDM for 201 days to 220 days. Few girls (8.68%) had MDM for less than 200 days. Out of total number of students irrespective of their gender, majority of students (63.27%) have had MDM for more than 220 days and the least number of students (10.20%) had MDM up to 200 days. Remaining students (28.37%) had MDM for more than 200 days to 220 days in school. The high intake of MDM among girls and boys is observed due to their regularity in school. The regularity of boys and girls might have influenced by availability of MDM in school.

**Figure 1: Percent of days the students had MDM**

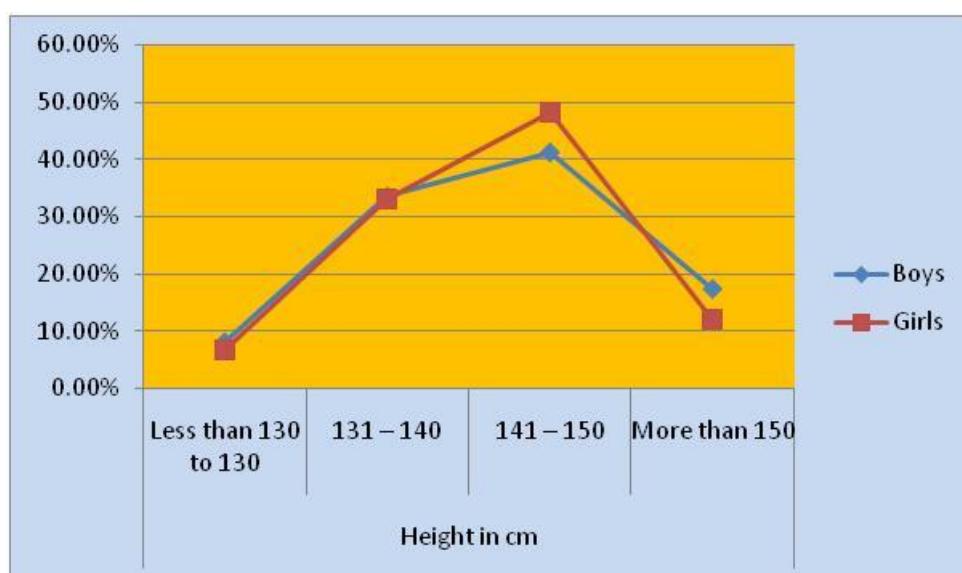
It is seen from the Graph 1 that girls had MDM for more numbers of days than boys as more girls had MDM for more than 220 days. Number of girls who had MDM for less than 220 days is less than boys. It indicates that girls had benefit of MDM in school more than boys. Girls seem to be more regular in school than boys which influenced their MDM intake in school.

Physical development		Boys	Girls
Age	< 13 years	7.26 %	13.64 %
	13 years	59.27 %	68.60 %
	> 13 years	33.47%	17.77 %
Height in Cm	< 130 to 130	8.06 %	6.61 %
	131 – 140	33.47 %	33.06 %
	141 – 150	41.13 %	48.35 %
	> 150	17.34 %	11.98 %
Weight in kg	< 30 to 30	30.65 %	28.51 %
	31-40	50 %	57.44 %
	41-50	14.11 %	13.22 %
	> 50	5.24 %	0.83 %

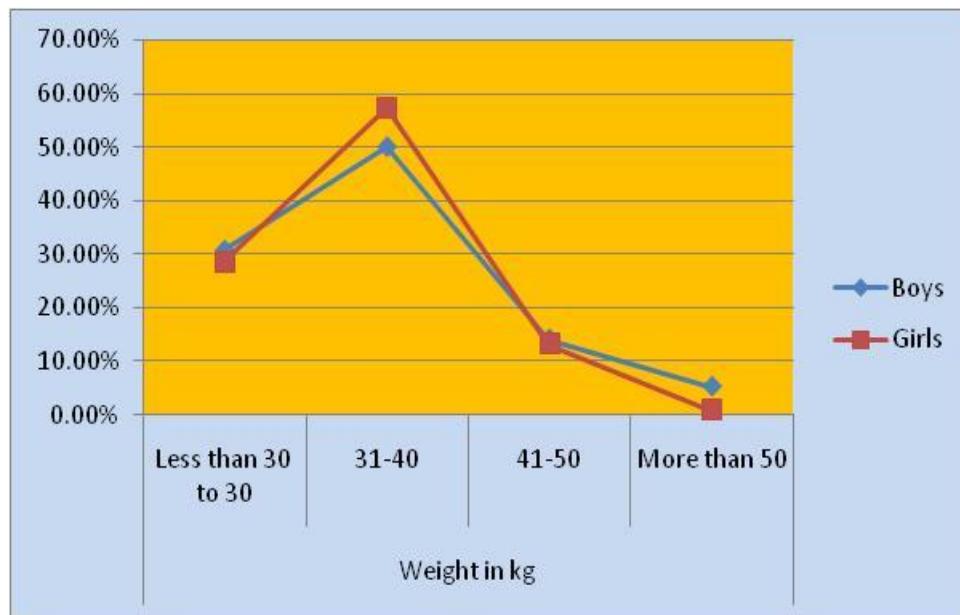
**Table 3: Physical development of students in terms of age, height and weight**

**Figure 2: Age of students in years**

It is seen from Graph 2 presented above that out of total number of students, there are more number of girls (68.60 %) who are 13 years old than boys (59.27 %). There are more boys whose age is 12 years and more than 13 years as compared to girls. More number of students belongs to age category of 13 years. It is interpreted that majority of students irrespective of any gender, have 13 years of age which is appropriate to be in class VIII. These students had age appropriate admission. The boys and girls who are not 13 years old have taken either early admission or late admissions in schools. Development of height and weight is dependent on age and gender of students so, age is important factor to analyze.

**Figure 3: Height of students in cm**

It is observed from Table 3 and Graph 3 that majority of students irrespective of their gender (41.13 % are boys and 48.35 % are girls) have height between 141 and 150 cm whereas the least number of students (8.06 % are boys and 6.61 % are girls) have height up to 130 cm. The boys (33.47%) and girls (33.06%) having height between 131 and 150 cm are almost equal. There are few students (17.34% are boys and 11.98% are girls) who have height above 150 cm. It can be interpreted that development of girl's height is better than that of boys.

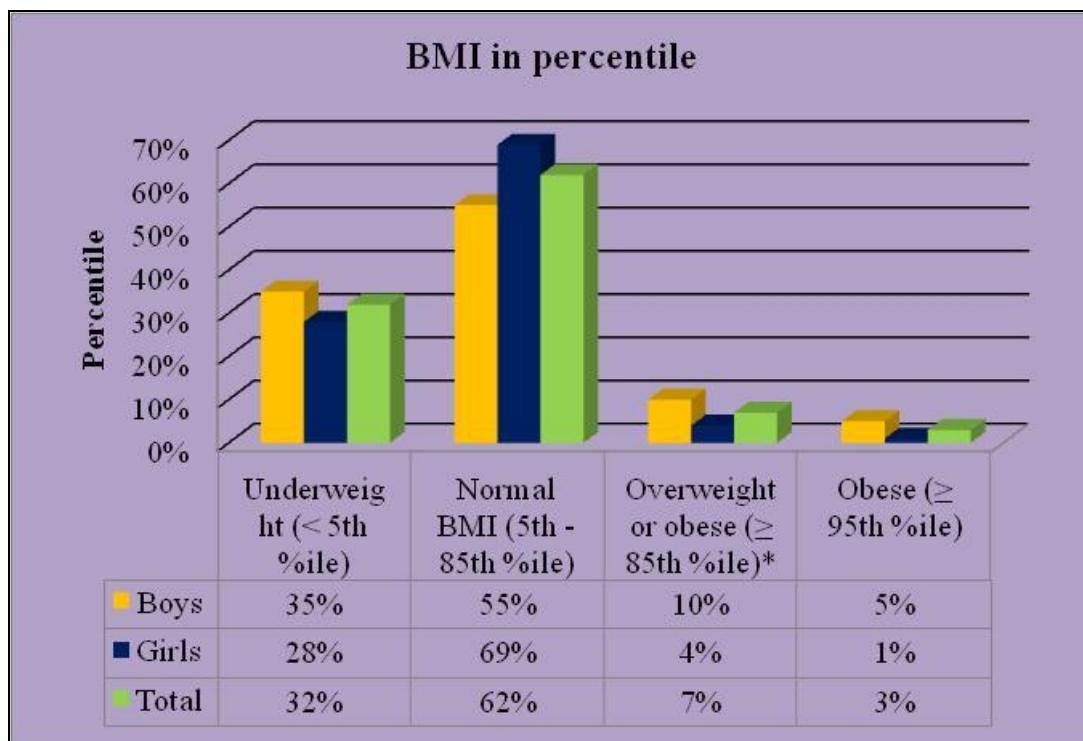


**Figure 4: Weight of students in kg**

It is seen from the Table 3 and Graph 4 that majority of students irrespective of their gender (50% are boys and 57.44% are girls) have weight between 31 and 50 kg whereas the least number of students (5.24% are boys and 0.83% are girls) have weight measuring more than 50 kg. The difference of weight between boys (14.11%) and girls (13.22%) is less for those who have weight of 41 kg to 50 kg. Remaining boys (30.65%) and girls (28.51%) have weight up to 30 kg. The growth of weight among boys is better than girls as more boys have weight above 40 kg than girls. But significant improvement in weight is observed among girls who have weight between 31 to 40 kg.

Thus, as per above analysis for physical development of students in terms of age, height and weight indicates that majority of students have age appropriate admission in school. Status of girls in terms of growth of height is better than boys whereas boys show improvement in terms of weight. The age appropriate ratio of weight and height shows the

health status of students which is presented in Graph 5. It indicates that the students have required amount of nutritious food as they have normal health.



**Figure 5: BMI of boys and girls in percentile**

After observing age, height and weight of boys and girls separately in Table 4, BMI calculation presented in Graph 5 shows the status of health among boys and girls. As per the data presented in Graph 1, majority of girls and boys have normal weight while the least numbers of boys and girls are overweight or obese. Remaining number of boys and girls are underweight. Number of girls in terms of normal weight is more than boys whereas number of boys in terms of underweight and overweight are more than girls. Thus, more boys are underweight, overweight and extreme obese than girls. Overall BMI of boys and girls indicates that health status in terms of age appropriate weight as per height of girls is better than boys as more girls have normal in terms of health status than boys.

Further, in term of the health status, underweight boys and girls indicate malnutrition due to lack of proper nutrition or lack of food. Overweight boys and girls indicate the slightly higher chances of being affected with several health issues which can be reduced by slight changes in diet and activities. Obese boys and girls have increased the risk of having several diseases and need to reduce weight by healthy eating. Though majority of boys and girls are

observed to be healthy, some boys and girls are observed to be either underweight or overweight which indicates the imbalance in diet of the students. Despite the fact that boys and girls had MDM in school as one time meal, the food habits of boys and girls and other meals at home also play a major role in health status of boys and girls.

### **Other important observations**

Majority of students irrespective of any gender had MDM intake for more than 220 days which is found to be appropriate as per guidelines that MDM has to be served in school for minimum 200 days in a year. Majority of students irrespective of any gender were 13 years of age as they had age appropriate admissions. Age appropriate height and weight as per guidelines provided by Indian Academy of Pediatrician (IAP) were found among majority of students. In terms of calculation of BMI of boys and girls majority of them have normal health status whereas girls have better health status than boys.

It indicates that the physical growth of students of class VIII was found to be appropriate according to age for which MDM would be one of the important aspects as majority of students had been served MDM in school for more than 200 days. These students had MDM as one time full meal for more than 200 days in school. Hence, MDM found to have positive impact on physical growth of students irrespective of any gender.

### **Discussion**

The intake of MDM among students who had MDM in school continuously during their elementary education in Surendranagar, Gujarat, is found to have fulfilled requirement of minimum intake guidelines given by government under the scheme of Mid day meal<sup>2</sup>. It confirms that MDM had been part of their one time meal on regular basis which might have facilitated the amount of required nutrition in food. Hence, one of the findings also shows the appropriate level of physical growth in terms of height and weight according to age among students, boys and girls<sup>1, 3</sup>. Overall, height and weight is appropriate and health status of boys and girls is normal. Though MDM intake is observed as per required number of days, the other meal at home also plays a major role. Heredity also plays a major role in physical growth of students which might have influenced the result of nutrition intake of students by MDM and other meal at home. The quality of other meal at home is dependent on the kind of food available at home as per their habit, requirements and also affordability of parents. The

overall result of the study shows that MDM as one time meal in school is one of the aspects for good health status of students.

The present study is limited to parameters in terms of number of days the students had MDM in school and growth of height and weight as per the age of students. Further, this study can be conducted by considering MDM and the other meal taken by students at home.

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# The Intriguing Flow Behavior of Soft Materials

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## Abstract

Materials that can be deformed by thermal stresses at room temperature are called soft materials. Colloidal suspensions comprising solid particles evenly distributed in a fluid phase (smoke, fog, ink and milk, for example), emulsions(mayonnaise, lotions and creams), pastes (tomato ketchup, toothpaste), granular media (a bag of rice or sand), and polymer gels (polysaccharide gels) can be categorized as soft materials and are ubiquitous both at home and in industrial setups. Soft materials exhibit rich flow and deformation behaviors characterized by intriguing properties such as shear-thinning or thixotropy, shear-thickening or dilatancy, non-zero normal and yield stresses, *etc.* This article explains some of the mysterious flow properties of soft materials.

## Keywords

Soft Materials, Complex Flows; Rheology

## What are soft materials?

Several materials that we see around us every day such as lotions and creams, foodstuff such as jelly and mayonnaise, shaving foam, detergents, dyes and paints, *etc.*, are easily deformed by thermal fluctuations at room temperature. As diverse as these materials seem, they have some basic features in common, and are commonly referred to as soft materials or complex fluids. So, what are these common features that these seemingly different materials possess?

“What do we mean by soft matter? Americans prefer to call it ‘complex fluids’. This is a rather ugly name which tends to discourage the young students. But it does indeed bring in two of the major features: *complexity* and *flexibility*.” These were the opening sentences of Professor Pierre Gilles de Gennes’ Nobel lecture (Physics) on December 9, 1991<sup>1</sup>. Soft materials are constituted by aggregates of molecules, or macromolecules, whose typical sizes are between 10 nanometers and 1 micrometer<sup>2</sup>. Atomic length scales, in comparison, are of the order of angstroms. Owing to their larger sizes, macromolecules that make up soft materials move much more slowly than molecules in atomic systems. These properties endow soft materials with the complexity and flexibility that de Gennes told us about several years ago.

Another important consequence of the mesoscopic or intermediate sizes of the constituents of soft materials is that the inter-macromolecular interactions, which are dominated by thermal fluctuations, are of entropic origin. The shear modulus, or the ratio of shear stress to the shear strain<sup>3</sup>, of a soft material is  $G \sim \frac{k_B T}{a^3} \sim \frac{4 \cdot 10^{-21} J}{(10^{-6})^3 m^3} \sim$  milli-Pascals (mPa) at room temperature.

The moduli of conventional solids such as wood are of the order of gigapascals, while the modulus of stainless steel is approximately a few hundred gigapascals.

As a result of the weak inter-particle interactions ( $\sim$  meV) that exist in these materials, small external perturbations can cause very large responses<sup>4</sup>. Examples of nonlinear behavior of soft materials therefore abound, for instance, the shear-dependent viscosity of a cornstarch suspension under an applied shear, pattern formation in an electrorheological fluid, etc. Indeed, these phenomena cannot be described by conventional Newtonian fluid mechanics<sup>5</sup>. Silly putty, for example, can be approximately modeled by assuming that its shear modulus is time-dependent, while shear thinning (decrease in viscosity under an applied shear) of colloidal suspensions such as blood or yogurt is described by modelling viscosity in terms of shear strain-rate dependent parameters.

Soft materials are characterized by rich out-of-equilibrium behavior<sup>4</sup>. Real-life examples include the formation of sand dunes (out-of-equilibrium pattern formation) and active dynamics (in living cells, such as in the transport of cargo along microtubules in a process driven by the hydrolysis of ATP). In this article, I shall introduce the reader to the intriguing flow and deformation behavior (rheology) of soft materials<sup>5, 6</sup>.

## I. Rheology: the study of the flow and deformation of matter

The flow of a soft material can be related to its structure and dynamics at the microscopic scale. Given the macromolecular nature of the constituents of soft materials, their structure and dynamics at the particle-scale are often studied using dynamic light scattering<sup>7</sup> or light microscopy<sup>4</sup>. Owing to the weak interactions that exist between constituent particles, small stresses can lead to dramatic macromolecular rearrangements and flow modifications in these materials<sup>5, 6</sup>. These flow modifications that happen at macroscopic length scales can be studied in the laboratory using a commercially available instrument called a rheometer<sup>5</sup>.

The mesoscopic sizes of the constituent units and the weak inter particle forces in soft materials result in flow properties that are usually not exhibited by atomic solids. The time duration over which a soft material, once forced, relaxes to its equilibrium state typically ranges between a few 100 nanoseconds to as long as a few seconds. This timescale is typically called the material's relaxation time.

Rheology is derived from the Greek words *ρεό* (reo-to flow) and *λογία* (logia-the study of). The term was coined by the American chemist Eugene Bingham and refers to the study of flow and deformation of matter. Historically, the mechanical behavior of materials under small deformations (linear rheology) was studied by ‘rheologists’, while that under complex deformations (nonlinear rheology) was studied by ‘mechanicists’. In this article, I shall first introduce the reader to the simple ideas that are used to describe linear rheology. Finally, I shall give some examples of the intriguing flow properties of soft materials under large complex deformations (nonlinear rheology).

### a. Why do we study rheology?

The study of flows is important in any industry where large-scale processes require the transport of materials. Many everyday objects such as lotions, foodstuff etc. can be characterized as soft materials. The understanding of flow and deformation is of great importance in material processing. That apart, soft materials are excellent candidates for scientists and engineers to study exciting and novel flow behaviors, particularly when the materials are sheared in their nonlinear rheological regimes. Specific observations will be discussed later in this article.

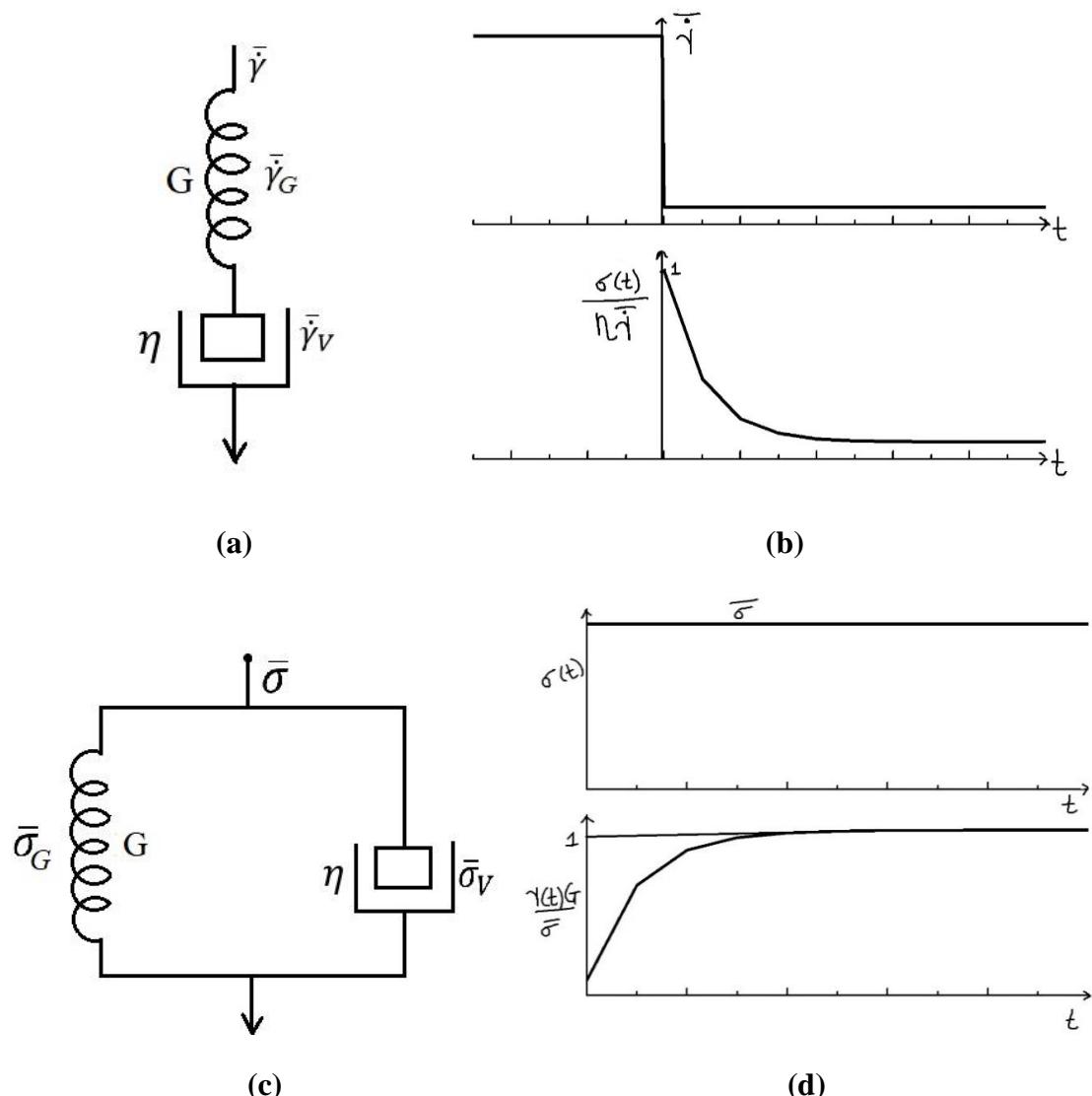
**b. Solids and liquids:**

Soft materials possess the unique property of *viscoelasticity*. Owing to the mesoscopic sizes and long relaxation times of the constituents when compared to atomic solids, soft materials exhibit solid-like (elastic) and liquid-like (viscous) properties at time scales accessible to us in the laboratory. Molecules of solids are tightly packed together which results in the material's *rigidity* and its *inability to flow*. Solids *store energy* and obey Hooke's Law which states that the stress response  $\sigma$  of a solid material is directly proportional to the strain  $\gamma$  applied on it:  $\sigma = G\gamma$ , where  $G$  is the bulk/ rigidity/ elastic modulus<sup>3</sup>. A solid-like material is pictorially represented by a perfectly elastic spring<sup>5, 6</sup>. Liquids, in contrast, can flow and take the shape of the container they are confined in. Furthermore, liquids *dissipate* energy and their mechanical behavior can be represented by the Newton's law of viscosity:  $\sigma = \eta\dot{\gamma}$  where  $\eta$  is the shear viscosity of the liquid and  $\dot{\gamma}$  is the rate at which the applied shear strain changes<sup>8</sup>. Liquids are represented by dashpots which are completely dissipative elements<sup>5, 6</sup>.

**c. Viscoelastic materials**

As discussed in the last subsection, viscoelastic materials can simultaneously display solid-like and liquid-like properties. Soft materials are viscoelastic and are often pictorially represented by canonical combinations of springs and dashpots. The simplest canonical combinations are illustrated in Figure 1. Figures 1(a) and 1(c) present the Maxwell and Kelvin models of viscoelasticity, which are respectively represented by a series and a parallel configuration of one spring and one dashpot. In both the illustrations, the spring represents an element with elasticity  $G$  while the dashpot represents an element with viscosity  $\eta$ . A fixed rate of strain  $\bar{\gamma}$ , when applied to the Maxwell model [Figure 1(a)], gets distributed between the two elements depending on the relative values of the characteristic mechanical parameters,  $\eta$  and  $G$ . As a direct consequence of the presence of the dissipative dashpot element, the stress-controlled Maxwell model is characterized by a stress decay over a relaxation time  $\eta/G$  when the constant applied strain  $\bar{\gamma}$  is suddenly removed [Figure 1(b)]. This is in contrast to the instantaneous dissipation of energy in a Newtonian liquid upon the application of a shear rate  $\dot{\gamma}$ . Aqueous solutions of giant wormlike micelles<sup>4</sup> are known to display Maxwellian behavior. In the Kelvin-Voigt model [Figure 1(c)], the strain builds up exponentially with a characteristic relaxation time  $\eta/G$  [Figure 1(d)] when a constant applied stress  $\bar{\sigma}$  is applied to it. This behavior

is in stark contrast to the instantaneously buildup of strain in a Hookean spring upon the application of a stress. The stress-controlled Kelvin-Voigt model can used to predict the *creep* behavior of viscoelastic solid-like materials. More complex rheological processes can be explained by using more complex arrangements of springs and dashpots<sup>6</sup>.



**Figure 1:** A schematic diagram showing the (a) Maxwell model with a dashpot (representing an element with viscosity  $\eta$ ) and a spring (representing an element of elasticity  $G$ ) connected in a series configuration. When a rate of shear strain  $\bar{\gamma}$  applied to this model is suddenly withdrawn, the stress  $\sigma(t)$  decays exponentially as shown in (b). (c) presents an illustration of a Kelvin-Voigt model, where the spring and dashpot are connected in parallel. When a constant shear stress  $\bar{\sigma}$  is applied, the strain  $\gamma(t)$  in the Kelvin-Voigt model, as shown in (d), builds up exponentially. The Maxwell and Kelvin-Voigt models are the two simplest canonical models of viscoelasticity.

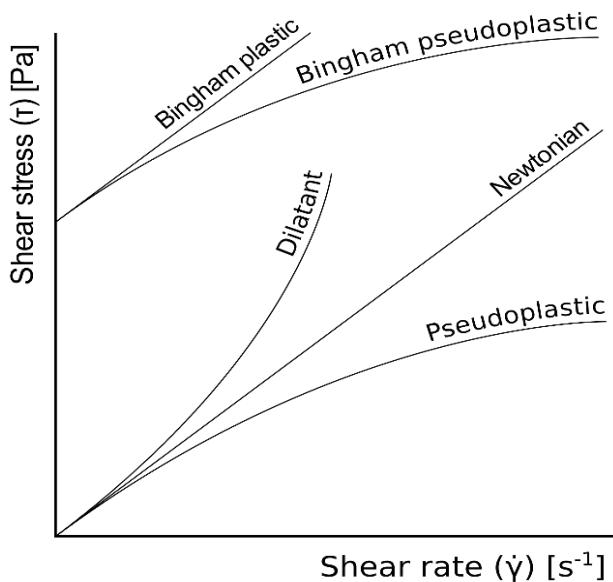
#### **d. Rheological responses**

Figure 2 shows examples of soft materials that we see around us every day. Many common food items (tomato sauce, jelly, mayonnaise) are viscoelastic<sup>5, 6</sup> and can be categorized as soft materials. The properties of these complex soft materials can be predicted to a limited extent by representing those using distinct combinations of springs and dashpots.



**Figure 2: Examples of everyday viscoelastic materials: from left to right -sand (granular matter)<sup>9</sup>, blood (a colloidal suspension)<sup>10</sup>, toothpaste (a gel)<sup>11</sup> and a soap foam (gas bubbles evenly distributed in a small amount of soapy liquid)<sup>12</sup>. The rheology of all these materials change dramatically due to the application of small stresses/ strains.**

Soft materials can have a range of responses. Figure 3 displays shear stress *vs.* shear strain rate plots that reveal a variety of mechanical responses that everyday viscoelastic materials display. In shear thinning or pseudo plastic behavior, often seen in blood, paint and ketchup, the viscosity (estimated from the slope of the shear stress *vs.* shear strain rate plot in Figure 3) *decreases* with increasing rate of shear. In dilatant or shear-thickening behavior, seen for example in suspensions of cornstarch particles subjected to appropriately high shear rates, the viscosity *increases* with increasing shear strain rate. In addition to these, two types of plastic responses are also illustrated in Figure 3. In contrast to shear thinning and shear thickening viscoelastic materials, plastic materials are characterized by the existence of a non-zero value of stress, the so-called yield stress, at a shear strain rate  $\rightarrow 0$ . Toothpastes and ketchups have non-zero yield stresses, which is why we have to squeeze the toothpaste tube or thump the ketchup bottle to make the contents flow. In a Bingham plastic, Hooke's law is obeyed once the yield stress is exceeded. In contrast, a Bingham pseudo plastic display shear thinning behavior under the same condition. A perfectly viscous or Newtonian response, where the shear stress is proportional to the rate of shear strain, is also illustrated in Figure 3 for comparison.



**Figure 3: Shear stress vs. shear strain rate plots for viscoelastic flows. Dilatants and pseudo plastic flows, commonly referred to as shear thickening and shear thinning respectively, and plastic flows are shown. Newtonian flow, where shear stress is directly proportional to shear strain, is also plotted.**

Figure courtesy: [https://upload.wikimedia.org/wikipedia/commons/e/e0/Non-Newtonian\\_fluid.svg](https://upload.wikimedia.org/wikipedia/commons/e/e0/Non-Newtonian_fluid.svg)

#### e. The superposition theorem and the theory of linear viscoelasticity

The superposition principle for linear viscoelasticity proposes that the response of a material (its shear stress  $\sigma(t)$ ) in the linear rheological regime is proportional to the initiating signal (the applied shear strain  $\gamma(t)$ ). The general equation for linear viscoelasticity is written as a linear differential equation of the form:

$$\left(1 + \alpha_1 \frac{\partial}{\partial t} + \alpha_2 \frac{\partial^2}{\partial t^2} + \dots + \alpha_n \frac{\partial^n}{\partial t^n}\right) \sigma(t) = \left(\beta_0 + \beta_1 \frac{\partial}{\partial t} + \beta_2 \frac{\partial^2}{\partial t^2} + \dots + \beta_m \frac{\partial^m}{\partial t^m}\right) \gamma(t) \quad \text{---(1)}$$

where  $n, m$  and the coefficients of the time differential terms ( $\alpha_1, \dots, \alpha_n, \beta_0, \dots, \beta_m$ ) are constants. In general, viscoelastic materials in the linear response regime are well described by Equation (1)<sup>6</sup>. It is easy to see that Equation (1) reduces to the Hooke's Law ( $\sigma = E\gamma$ ) when  $\beta_0 = G$  (elastic modulus)  $\neq 0$  and all other coefficients are 0. Similarly, Equation (1) reduces to the Newton's law of viscosity ( $\sigma = \eta\dot{\gamma}$ ) when  $\beta_1 = \eta$  (shear viscosity)  $\neq 0$ . Viscoelastic behavior ensues from Equation (1) when 2 or more coefficients are simultaneously non-zero. For example, the Kelvin-Voigt model of viscoelasticity (the pictorial depiction can be found in

Figure 1(c)) is obtained if  $\beta_0 = G \neq 0$  and  $\beta_1 = \eta \neq 0$  in Equation (1). Under these conditions, the equation reduces to

$$\sigma(t) = G\gamma + \eta\dot{\gamma} \quad \text{-----}(2)$$

If a constant stress  $\bar{\sigma}$  is applied to the Kelvin-Voigt model at  $t \geq 0$ , the shear strain response, computed by solving Equation (2), shows a time-dependent buildup in shear strain  $\gamma(t)$  that has been displayed in Figure 1(d) and can be described by the equation:

$$(t) = \frac{\bar{\sigma}}{G} \left[ 1 - \exp \left( -\frac{Gt}{\eta} \right) \right] \quad \text{-----}(3)$$

For modeling a range of viscoelastic materials using Equation (1), we consider different combinations of springs and dashpots by assigning appropriate non-zero values to the time-independent coefficients in Equation (1). Simpler canonical models involving only 2 elements, such as a spring and a dashpot in series or in parallel as shown in Figure 1, can be solved analytically. More complicated models are amenable only to numerical solution.

#### **f. Measurement of linear and non-linear rheology**

To understand the rheology of a material subjected to small deformations that lie within the linear rheological regime, the following experiments are performed to measure small strain relaxation functions<sup>5, 6</sup>.

**i) Stress relaxation experiments:** the stress relaxation function  $G(t) = \frac{\sigma(t)}{\gamma_0}$  is computed by measuring the stress relaxation  $\sigma(t)$  as a function of time  $t$  at a constant step strain  $\gamma_0$ .

**ii) Creep and recovery measurements:** The time-dependent creep compliance  $J(t) = \frac{\gamma(t)}{\sigma_0}$  is estimated by measuring the time dependent shear strain response  $\gamma(t)$  under a constant applied step shear stress  $\sigma_0$ .

**iii) Oscillatory measurements:** The angular-frequency dependent elastic and viscous moduli,  $G'(\omega)$  and  $G''(\omega)$  respectively, are measured. This is achieved by measuring the amplitude of the oscillatory shear stress response  $\sigma_o$  and the phase difference  $\delta$  between the applied oscillatory shear strain  $\gamma(t) = \gamma_0 \sin(\omega t)$  and the oscillatory stress response  $\sigma(t) = \sigma_0 \sin(\omega t + \delta)$ . A complex shear modulus  $G^*$  is derived from the ratio of the measured

oscillatory shear stress and the applied shear strain. The real part of  $G^*$  is the elastic modulus  $G'(\omega)$  while the imaginary part gives the viscous modulus  $G''(\omega)$ .

The small strain relaxation functions discussed above can be measured using an instrument called a rheometer. Images of an Anton Paar rheometer MCR 501 and some commonly used rheometer geometries are shown in Figure 4. Rheometers<sup>4</sup> can apply oscillatory and rotational shear strains or shear strain rates while simultaneously measuring shear stresses very accurately. The reverse experiment, wherein shear stresses are applied and shear strains/ shear strains rates are measured, can also be performed.

For higher strain values, it is difficult to compute relaxation functions using standard rheological models. The standard constitutive relations do not apply and a new treatment becomes necessary. Some theoretical models, such as those for second order fluids, have been proposed<sup>5</sup>. In spite of some advances, our understanding of flow and deformation properties of materials under large stresses or strains continues to be based largely on experimental observations. We will now briefly discuss some intriguing observations that arise in materials in the non-linear rheological regime.



**Figure 4:** (Left) An Anton Paar stress-controlled MCR 501 rheometer in the author's lab. In this picture, the rheometer is being operated by an ex-member of our laboratory, Dr. Paroor Harsha Mohan. (Right): Pictures of some commonly used rheometer geometries. Samples (shown in blue) are loaded in the geometry (usually made of stainless steel and depicted in grey). Oscillatory and rotational strains/ stresses are applied on the sample by the geometry and the stress/ strain responses are measured using a motor-transducer assembly.

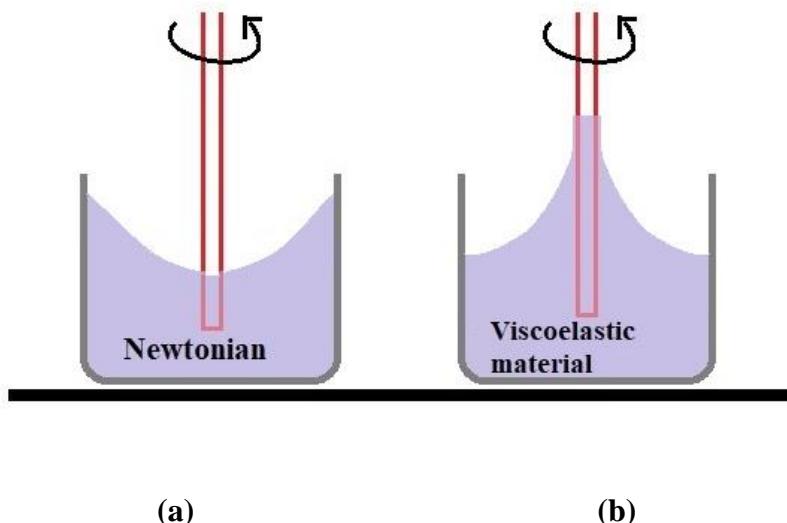
**Picture courtesy:**

[https://en.wikipedia.org/wiki/Rheometer#/media/File:Rotational\\_geometries.png](https://en.wikipedia.org/wiki/Rheometer#/media/File:Rotational_geometries.png)

#### *g. Nonlinear rheology of soft materials: some characteristic parameters and observations*

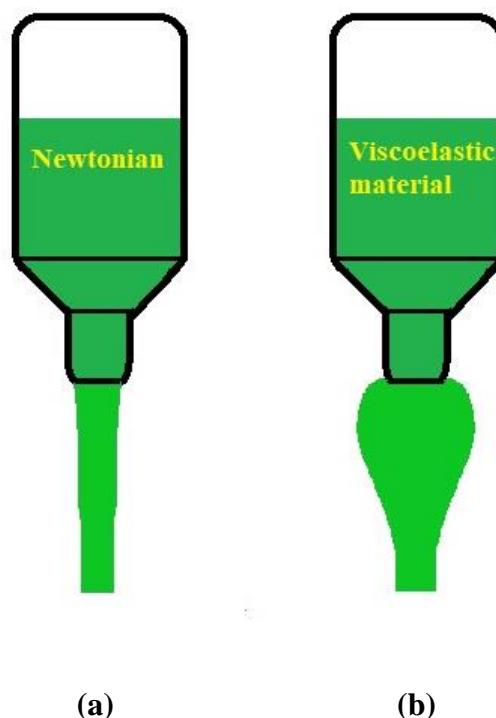
The nonlinear rheology of soft materials is characterized by non-zero normal stresses, shear thinning, and shear thickening etc.<sup>5</sup>. These properties, absent in conventional solids and liquids, arise due to rearrangements in the macromolecules constituting the microscopic structures of soft materials when large strains and stresses are applied. Below are some interesting observations that arise due to the complex nonlinear rheology of some common soft materials.

**i) Weissenberg Effect:** When a spinning rod is inserted in an elastic complex fluid (like a dense viscoelastic polymer solution), the sample, instead of being thrown outward as expected for a Newtonian fluid, moves towards and climbs the rod<sup>5</sup>. This is known as the Weissenberg effect, also referred to as the rod climbing effect. This effect arises due to positive normal stresses that characterize viscoelastic materials in flow. In contrast, a Newtonian liquid, when stirred, will move towards the edge of the container due to inertial forces. Figure 5 depicts the Weissenberg effect pictorially. Videos of rod climbing by viscoelastic fluids can be found at <https://nnf.mit.edu/home/billboard/topic-5>.



**Figure 5:** (a) When a Newtonian liquid is stirred, the liquid interface is higher at the rims of the container than in the center. (b) A viscoelastic material, in contrast, climbs the spinning rod.

**ii) Barus effect:** Dye swell, also known as the Barus effect, is seen while squeezing a dense soft material like an aqueous polymeric solution out of a small orifice<sup>5</sup>. The polymer swells immediately upon exiting the orifice. This can be understood by considering that polymers in a poor solvent like water prefer to exist as tiny globules. The polymers experience high shear rates during their passage through the orifice and are stretched out (shear thinning behavior) in the direction of their flow. Immediately after exiting the orifice, the polymers coil up into globules again and the material swells. This is depicted pictorially in Figure 6. A video of a viscoelastic polymer solution exhibiting the Barus effect can be found at <https://www.youtube.com/watch?v=KcNWLIpv8gc>.



**Figure 6: (a) When a Newtonian liquid is squeezed out of an orifice, the diameter of the exiting liquid is the same as that of the orifice. In contrast, a viscoelastic material swells upon exiting the orifice as shown in (b).**

**iii) Fano flow:** Fano flow, also known as the tubeless syphon effect, is an observation that arises in elastic fluids due to their high extensional viscosity<sup>5</sup>. Extensional viscosity refers to the increase in a material's viscosity under extension. This property can be used to effectively siphon an elastic liquid out of its container using a syringe. Interestingly, the syringe can draw

out the elastic liquid even without touching the surface of the latter once the siphoning initiated. A video of Fano Flow can be found at <https://www.youtube.com/watch?v=aY7xiGQ-7iw>.

**iv) Kaye effect:** An elastic liquid that is poured down an inclined plane shear thins as it slides down the plane. Thin jets of the elastic liquid are seen to spout out occasionally. This effect has been demonstrated even in shampoos and liquid soap. A video of the Kaye effect can be found at <https://www.youtube.com/watch?v=wmUx-1o3Lzs>.

**v) The bizarre flow of cornstarch suspensions:** A dense suspension of cornstarch particles behaves like a Newtonian liquid when stirred gently. On the other hand, the suspension solidifies if stirred vigorously. This counter-intuitive behavior arises due to the complex, non-monotonic flow behavior of cornstarch suspensions<sup>13</sup>. A nice video illustrating this phenomenon can be found at <https://www.youtube.com/watch?v=Ja-6JtEZ7lk>.

## Conclusions

This article describes some interesting observations related to the flow of soft materials. On account of their sizes and relaxation times, soft materials are ideally suited for rheological measurements. The wide applicability of soft materials in our day to day lives and in industrial settings makes the study of their rheology extremely important. The interested reader may refer to a recent review by the author <sup>14</sup> for a more detailed monograph.

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# Human Dignity- A Kantian Perspective

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## Abstract

The present work is an effort to understand Kant's formulation of human dignity and how the concept, over the years, have influenced and enriched the growth of different but related concepts like autonomy and freedom. Kant's contribution to the modern understanding of dignity can be understood in the manner in which he shifted the traditional focus of dignity based on social standing to respect of persons in their autonomy. In the context of modern society, human dignity provides the normative basis for the moral treatment of individuals and Kant was one of the earliest philosophers who made a lasting contribution in this regard.

## Key words

Kant, Dignity, Autonomy, Morality

## Introduction

Conceptually speaking, human dignity connotes the basic idea that human beings possesses an intrinsic and incomparable moral worth, in virtue of which they are worthy of respect or 'ought to be accorded a form of moral recognition'<sup>1</sup>. Indeed, as a matter of philosophical inquiry, human dignity provides a normative guideline for understanding how human beings ought to be morally treated. And as a matter of legal philosophy, human dignity provides the foundational basis of some of the most important human rights guarantee of the post-war era. In recent times human dignity has often been used to defend and further claims of personal autonomy, right to privacy, reproductive choices, sexual orientation and other related things. In *Puttaswamy v Union of India*,<sup>2</sup> for example, the Supreme Court relied on a Kantian theory of dignity to evaluate the validity of the Aadhaar Act. On one side of the

equilibrium the petitioners challenged the intrusive nature of the Act, which, they alleged, created an ‘architecture for pervasive surveillance’. On the other hand, the government justified the legislation as a “means of authentication for availing services, benefits and subsidies”. In chartering a middle ground, the Supreme Court unwittingly reduced the issue as the right to privacy on one hand and the right to dignity on the other. Interestingly, while Kant has written very little about privacy, one can find implications of it in his treatment of autonomy. Essentially, therefore, *Puttaswamy*brought two fundamental Kantian principles against one another in an historical interface between law and philosophy.

### **Kantian Dignity and Autonomy**

Dignity, as Kant understood it, is not an achievement or a title imposed upon a person for something he has done or for his position in the society.<sup>3</sup> It is an integral part of a rational existence which can neither be given or taken away. In his work *Politics of Recognition'* Charles Taylor's describes human dignity as having emerged from and against the ancient idea of honour.<sup>4</sup> Similar claims are made by Michael Sandel who observes that while honour ‘ties persons to the roles they inhabit, dignity resides in a self, antecedent to social institutions’.<sup>5</sup> This seeming contrast between dignity and honour reinforces a fundamental axiom of Kantian ethics: that human dignity and not honor is the basis of respect. In *Puttaswamy*, the Supreme Court reiterates this idea by associating dignity with conduct that is consistent with treating a man “as a full member of the human community”.

But what is human dignity? And what does it consist of? The most authoritative formulation of dignity can be found in Immanuel Kant's work “*Groundwork of the Metaphysics of Morals*.<sup>6</sup> In his book, Kant draws a picture of dignity that resonates with his own conception of autonomy. Kant defines autonomy as the ‘property of the will by which it is a law to itself. It is a curious and even so an intriguing definition of a concept, which in the context of modern liberalistic milieu underlies our deep affection for freedom. Modern discourse on autonomy transcends a variety of topics that encompasses not only the freedom to makes choices but also the need for an inclusive society.<sup>7</sup> Thus, the contemporary understanding of autonomy involves not only the capacity to make individual choices but also the duty to respect others' choices. In a democratic setup, autonomy is increasingly relied upon as a constraint on state power and serves as a major force against state paternalism. Besides, it

also features regularly in debates on important, albeit, controversial issues like reproductive choices, sexual preferences, inter-faith conversion and the right to die.

Kant's contribution to the modern understanding of dignity can be understood in the manner in which he shifted the traditional focus of dignity based on social standing to respect of persons in their autonomy.<sup>8</sup> Dignity is derived from the Roman word 'dignitas', and traditionally understood, it referred to the social standing of a person based on the social hierarchy.<sup>9</sup> Dignity understood in this sense was attached to a person in virtue of his or her social or political standing.<sup>10</sup> Kant gave dignity the status of a moral worth which is common to all rational beings. On this account therefore Kant's contribution to the development of dignity consists in attaching in each human being "an equal and unconditional worth grounded in moral autonomy".<sup>3</sup> Outlining Kant's contribution to the development of dignity, Sullivan argues "that Kant's entire moral philosophy can be understood as a protest against distinctions based on the far less important criteria of rank, wealth and privilege".<sup>11</sup> As Dillon argues, it is Kant's insistence on giving a moral worth to dignity that makes him the first major Western philosopher to put respect for persons "at the very centre of moral theory".<sup>1</sup>

In contrast, Kant understands autonomy not in terms of the freedom to make choices but as the intrinsic capacity of rational beings to act according to the moral law.<sup>6</sup> In the Kantian universe a rational being is someone who in virtue of their rationality has the unique capacity of setting ends for themselves.<sup>12</sup> While some of these ends are the consequences of empirical and psychological factors working their way through our minds (which Kant refers to as heteronomy); Kant argues that only such acts of rational beings have moral worth which are derived from the principles which one as given to oneself.<sup>12</sup> Indeed, much of Kantian ethics is devoted to the search for these principles, which Kant believes would serve as a standard for determining the moral worth of an action. In the *Metaphysics of Morals*, Kant argues that the moral worth of an action, and more so its distinct authority, depends on it being governed by a superior law that is objective and universal for all rational beings at all time. Indeed, for Kant, any act that draws its causality from external sources are valid only to the extent that they are desired by the doer of the action. For instance, the duty to eat is valid only if a person desires to satisfy his hunger. This gives the duty to eat an instrumental value as far as satisfying one's hunger is concerned. Kant is averse to giving an instrumental value to duty.<sup>13</sup> Firstly, he claims

that such duty is inconsistent with the idea of a good will and secondly, he believes that only such actions have moral worth which are done from duty or in conformity with duty.<sup>12</sup>

### **Kantian autonomy and its relationship with dignity**

Kant observes that moral requirements are requirements of practical reason. To act morally would imply acting under certain directions that are unconditional. These directions that constitutes the fundamental principles of all our moral duties are referred to as the Categorical Imperative.<sup>12</sup> Kant devotes a major part of his work in building justification for the grounds of the categorical imperative. Since these principles apply to us irrespective of our inclinations or antecedent goals, a question is bound to arise: what is the basis of a categorical imperative and what function does it serve? A pervading idea throughout Kant's treatment of the categorical imperative is that if moral requirements are unconditional, then it must be based on an end whose value is absolute and which does not derive its worth from being an object of our desire; an end, in other words, which is of unconditional worth or value.<sup>6</sup> Such an end would not only be an end in itself but would also be deserving of some specific treatment.<sup>14</sup> Writing on this specific point, Kant observes that "rational nature exists as an end in itself."<sup>12</sup> It is in the concept of rational nature, that Kant also identifies an unconditional and intrinsic value which he refers to as 'dignity'.<sup>15</sup> For Kant, dignity underpins the supreme principle of morality and all the moral requirements that are derivable from the principle. Hence, he regards dignity as consisting of the inherent worth of human beings, which grounds a duty to treat people as ends in themselves.

Latent to the idea that people are ends in themselves is the fundamental Kantian postulate that dignity is inherently associated with autonomy. Kant observes that "Autonomy is... the ground of dignity of human nature and of every rational nature". Accordingly, Kant implies that to 'treat people with dignity' is to treat them as autonomous individuals able to choose their destiny". Kant also believes that possessing dignity has certain consequences that manifests in an individual's relationship with other persons: 'that he ought to be respected by other persons and at the same time he ought to be able to value himself equally to them.'<sup>14</sup>

## Dignity and Respect

But what is about persons that makes them worthy of respect? And what does that respect entail? The Kantian notion of a person - as being an end in itself - has numerous implications, one of which is his status as a moral being.<sup>16</sup> It is this status that differentiates him from animals and makes him capable of an autonomous existence.<sup>15</sup> It is also this status that gives his person a moral worth: a value which he possesses not by reason of being an object of desire but in virtue of his own being. Kant believes that it is this value, this intrinsic worth of being an end in itself, which is worthy of respect.

In the Metaphysics of Morals, Kant writes that respect manifests in conduct (and sometimes attitude) that treats the '*humanity in one's own person or the person of any other, not merely as means but as an end in itself*'.<sup>6</sup> In Kantian terms, it is not wrongful for a person to be treated as means to an end. Indeed, it was never Kant's idea, as some have suggested, that people ought to be treated only as ends and not as means to an end; Kant knew it well that for social existence to continue people have to rely upon each other for fulfilling their ends. What Kant found morally repulsive was treating people *merely* as means to an end and disrespecting their moral worth in the process.

A major implication of the 'end in itself' Kantian thesis is that it marked a remarkable shift in aligning respect with moral worth, as compared to the aristocratic policy of associating it with rank, honor or social or economic position of a person. In contemporary times this shift is evident in the realization that people, irrespective of their rank, honor or position and despite their moral and ethical disposition, possesses dignity and hence are entitled to respect. Today the idea of human dignity is ubiquitous in all instrumental recognition of human rights and regularly serves as the underlying basis of all constitutional rights and guarantees.

## Inferring Privacy claims from Kant autonomy

While Kant himself wrote very little about privacy, there are implications for privacy in his writings on autonomy and dignity. A point worth noting about the Kantian conception of dignity is that because dignity is an absolute worth and inheres in a person in virtue of his rational capacities, its existence is not conditional on a rational application of these capacities. Dignity inheres in a person irrespective of his propensity to live an immoral life; entailing that

even under such circumstances the dignity in his person ought to be respected. Thus, underlying the duty to respect dignity is also the duty to leave people alone: a normative premise that underpins the operation of privacy in practice. As will be shown later, the duty to leave alone finds further embodiment in the Kantian duty to others.

Similarly, central to Kant's moral philosophy is the claim that an autonomous choice is a moral choice that stems from the exercise of one's rational faculty.<sup>17</sup> And though, in making the choice one may act against existing moral norms, it does not give others a reason to humiliate and disrespect the dignity in him. Interestingly, one can find echoes of this claim in the Supreme Court's decision in *Navtej Singh Johar v Union of India*<sup>18</sup>, wherein it was held that individual choices, like matters of sexual preference cannot be barred on the grounds of societal morality.

As said earlier, one can also draw finer implications of privacy from a Kantian ethical theory. Kant divides duties into duties to oneself, consisting of all duties to promote one's self-perfection, and duties to others regarding their happiness. Kant classifies duties to others into positive duties and negative duties. Positive duties for Kant consist of all such acts which demonstrate sympathy, beneficence, love, gratitude, and respect for others. Of course, we cannot possibly construe Kant as suggesting that it is only when a person acts in conformity with the moral laws that one has a positive duty towards him. On the contrary, Kant believes that positive duty to others is absolute and unqualified and is not contingent on the moral quality of others' acts. A small clarification, however, may not be out of order here. While the Kantian duty to others is premised on the idea of providing happiness to others, Kant does not suggest that there is a positive duty on our part to make others happy. All that Kant requires is that in our duty to others, our act reflects all those qualities that are necessary to make others happy. As for negative duties, Kant includes all such acts which one should avoid in their dealings with others. For example, Kant notes that one must avoid such acts which shows envy, ingratitude, malice, arrogance, defamation, and ridicule to others. Notably, each of these points, either individually or cumulatively consists all the conditions that are both necessary and sufficient to sustain privacy claims. Moreover, since these duties do not entail any positive act on the part of the doer, there is also an implicit duty of non-interference in the choices that others make regarding their life.

As can be understood, both duties converge in creating an opportune environment where privacy claims can be easily sustained. While positive duties entail acting towards others only if there is something to contribute by way sympathy, gratitude, beneficence or respect; negative duty prohibits one from being skeptical of others' choices. Therefore, implicit in both the duties is the duty to leave others alone while respecting the choices they make in the exercise of their freedom

In *Puttaswamy*, the Supreme Court drew copiously from Kant's theory of dignity in shaping justifications for the right to privacy as a fundamental right. Writing on the intrinsic value of dignity the Court observed that,

'The intrinsic value of all individuals results in two postulates: anti-utilitarian and antiauthoritarian. The former consists of the formulation of Kant's categorical imperative that every individual is an end in him or herself...The latter is synthesized in the idea that the State exists for the individual, not the other way around.<sup>2</sup>

The reference to an anti-authoritarian state in the context of dignity is very suggestive. Indeed, it is only in an anti-authoritarian regime that the Kantian notion of 'humanity as ends' finds optimum realization. A noteworthy aspect of dignity - besides its moral worth – is its normative worth, reflected in its potential to limit the powers of the state. In an anti-authoritarian state this potential is entrenched in the basic rights of the people protected under a Constitution and frequently serves as a bulwark against the excesses of the state.

The Kantian duty to respect the 'dignity of humanity' applies not only to the dignity of others but also to the dignity one possesses as rational beings. To drive home, the point, Kant recognizes a set of duties that an individual has towards his own perfection. Among the set of duties that promotes self-perfection, Kant gives special emphasis to the duty to become virtuous. He firmly believes that only by practicing virtue one could abide by the duties not only to oneself but also to others at the same time. In *Puttaswamy*, the Supreme Court construes this duty in terms of freedom. The Court observes,

The second tendency of the Kantian criterion of justice was found in reinterpreting freedom in terms not merely of absence of restraint but in terms of *attainment of individual perfection* (*emphasis supplied*)<sup>2</sup>

A noteworthy thing about this passage is that by defining freedom in terms of attainment of individual perfection, it also associates the conditions for the pursuit of perfection within freedom itself. Going by this definition, freedom entails not only the attainment of individual perfection but also the *creation* of those conditions under which the pursuit of individual perfection is possible. In *Puttaswamy*, the court observes that the primary obligation to create these conditions rests with the state, while also treating the corresponding entitlement arising out of it as a fundamental right. The Court sees this duty as implicit within the Preamble of the Constitution, which it argues prohibits ‘statism’. Besides, the Court also locates this duty within the state’s own obligation under the Directive Principles of State Policy, including its commitment under various human rights instruments in International Law.

Today, the notion of a constitutional governance resonates powerfully with the Kantian idea of dignity. In a sense, it also helps contextualize the idea of constitutionalism and help further the idea that individuals do not stand in an instrumental relationship with the state. In *Puttaswamy*, the Court’s reference to an anti-authoritarian regime in the context of dignity is not without its significance. As the court rightly said, it is the state that exists for people and not the other way round indicating thereby that for state legitimacy to stand the state should respect the dignity of its people.

## **Conclusion**

In conclusion, it should be noted that the strategy of aligning dignity with fundamental human rights is not something done out of choice but is inevitable to the human condition. Indeed, this is the premise on which Kant builds his theory of autonomy and dignity. And even though Kant’s contribution to political philosophy may have been minuscule as compared to his other works, it cannot be denied that he helped humanize the foundation on which our political edifice is built.

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# Recent Scenario of Medicinal Plants of India in Cancer Therapeutics

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## Abstract

A severe metabolic syndrome, cancer ranks at the second position as a cause of mortality and morbidity worldwide. Not only is there a high death rate associated with cancer but also are threats of chemotherapeutic resistance and the numbers are increasing each year. Thus novel therapeutics in cancer treatment is aimed to design anti-cancer drug that is having reduced side effects. In this regard, phytotherapeutics is one of the most promising candidates. India has a rich heritage for large number of medicinal and aromatic plants that have been cited in Ancient Hindu texts such as Shushrut Samhita, Atharva Veda and Charak Samhita as well. These plants have several medicinal phytomolecules that are proven to be used for healthcare. In this case, bioactive compound, which is derived from medicinal plants are reported for their lesser or no side effects, and better healing properties and targeted action on cancer cells and not altering normal cells. Tumor development is a very complex process regulated through multiple cellular signaling and gene regulation. Phytochemicals are playing a major role by targeting multiple concerns and hence they are playing a crucial role in drug discovery in Cancer therapeutics studies today. The present article deals with reviewing twelve different medicinal plants of India that have been promising candidates found to be clinically active against various types of cancer cells. The activity of these plants has been mentioned in Ayurveda and ancient scriptures and preliminary studies have proven the same scientifically. However, the attempt of the present article is to review the capabilities of these plants for cancer treatment.

## **Keywords**

Cancer, Medicinal plant, Phytotherapeutics, Bioactive compound

## **Introduction**

Cancer is a heterogeneous disease involving uncontrolled cell growth with potential to invade other parts of the body. According to the World Health Organization (WHO), it is one of the major public concerned and second most life-threatening diseases. The report of International agency for research on cancer gives the estimated number of cancer incidents as 24,500,000 and mortality 12,500,000 by 2030.<sup>1</sup> If we consider 2018 as a base line, the main types of cancer leading to overall cancer mortality each year are: Lung [13,00,000 deaths/year], Stomach [8,03,000 deaths/year], Colorectal [6,39,000 deaths/year], Liver [6,10,000 deaths/year], Breast [5,19,000 deaths/year].<sup>2</sup> The most frequent type of cancer reported worldwide among men are: lung, stomach, liver, colorectal, esophagus and prostate cancer, while breast, lung, stomach, colorectal and cervical cancer are prevalent among women.<sup>2</sup>

In Cancer therapeutics, every year there are new breakthroughs in research but the incidences and mortality rates are also increasing for last 30 years. Heterogeneity of cancer leads to complexity in therapeutic research creating new hurdles every time. However, an in-depth understanding of molecular mechanisms leading to malignancy and cancer metastasis is a crucial point to be studied in the current phase of cancer treatment and prevention.

There are several synthetic drugs that are being used currently for cancer treatment in medical science but due to their high cost and vast side effects, clinically they have not succeeded in healing cancer completely as a result. It has pushed to the scientific community to look out for phytotherapeutics option using medicinal plants with these capabilities to cure heterogeneous disease like cancer. Indian flora has been an attraction for scientific community worldwide.

In the recent past, there has been significant advancement in cancer treatment with surgery radiotherapy, chemotherapy, immunotherapy, target therapy, vaccination, combination therapy, stem cell transformation therapy being in its advanced states. However, all these have toxic side effects, poor pharmacodynamics properties, resistance to metastasis, poor bioavailability and non-specificity limiting their clinical utility to a large extent. Recent

anticancer therapy not only cures the diseases but also causes several side effects.<sup>3</sup> There are several examples of synthetic drugs reported in literature related with their side effects (Table 1). In human body, there are cells which multiply rapidly under normal physiological conditions like hair follicle cells, bone marrow cells and digestive tract cells. Most of the anticancer drugs target these rapidly dividing normal cells along with cancerous cells leads to harmful side effects like decreased blood production, gastrointestinal tract inflammation, hair loss, immunosuppression, heart diseases and nervous disorders. There is a greater challenge to overcome these side effects that has taken the front seat for clinical intervention. Cell resistance is an another major limitation of these drugs due to their capability to induce mutations for e.g., drug resistant genes (ABCA4 and ABCA12) were highly expressed in human MCF-7 breast cancer cells respectively when docetaxel was used as a treatment. However, by applying curcumin in association with docetaxel, down regulation of drug resistance genes was observed.<sup>4</sup> There are several studies that have convincingly proved that phytotherapeutics are better than their synthetic counterpart. Thus, treating cancer by combinational therapy including synthetic drug with phyto-constituents has shown promising outcomes than employing mono-target through single chemical agent. Therefore, based on extensive research findings, phytochemicals and their derived analogues proven to be encouraging candidates for treating cancer.

<b>Sr.No</b>	<b>Drug</b>	<b>Mechanism of Action</b>	<b>Side effect</b>
1	Doxorubicin	Topoisomerase inhibitors	Cardiotoxicity
2	Oxaliplatin, Melphalan, Carboplatin and Cyclophosphamide	Alkylating agents	Nephrotoxicity, Gastrointestinal, Cardiovascular toxicity, Pulmonary and Hematologic-toxicity
3	Cisplatin (cis-di ammine, di-chloro platinum, DDP)	Cell cycle arrest and apoptosis	Nephrotoxicity
4	Taxanes : Paclitaxel, Docetaxel, Vinblastine and	Tubulin polymerization	Cardiovascular toxicity, Pulmonary and Hematologic-

	Discodermolide		toxicity
5	Gefitinib	Tyrosine kinase inhibitor	Cardiotoxicity
6.	Corticosteroids: Prednisone, Methylprednisolone, Dexamethasone	Allergic reaction prevention	Gastrointestinal Toxicity
7.	Anthracycline: Epirubicin Idarubicin, Valrubicin	Topoisomerase II Inhibitor	Cardiotoxicity, Febrile neutropenia
8.	Anti-metabolites: Methotrexate Nelarabine, Pemetrexed (Alimta), Pentostatin Pralatrexate, Thioguanine	DNA Replication Inhibitor	Inflammation
9.	Nitrosourea: Carmustine Lomustine, Streptozocin	Act against Brain Tumor	Pulmonary fibrosis

**Table 1 : List of Anti-cancer drugs and their side-effects <sup>3,4</sup>**

### ***Medicinal plants and Cancer***

There are several plants studied for cancer therapeutics till now. The National Cancer Institute (NCI) has screened approximately 35,000 plant species for possible anticancer activities. However, among them, about 3,000 plant species have demonstrated effective anticancer activity.<sup>5</sup>

Medicinal plants and their bioactive compounds play crucial roles in ancient medicinal practices. Several medicinal plant species and their phytochemicals inhibit the progression and development of cancer and also have demonstrated properties to inhibit cancer cell activity such as inhibiting proliferation of cancer cells and inducing apoptotic cell death.<sup>6</sup> Ongoing research is being done throughout the world in cancer therapeutics i.e. chemotherapy which includes the high risk dosage of chemical drugs at the same time it leads to high toxicity. Medicinal plants treat cancer through the phytochemicals, naturally present

with antioxidant and anticancer activities that are known to inhibit carcinogenic cells progression without showing any toxicity in individual. Phytochemicals and their derived analogous present in different parts of the plant, e.g., flower, stigmas of flower, pericarp, sprouts, fruits, seeds, roots, rhizomes, stem, leaf, embryo, and bark have several pharmacological functions. Several phyto-constituents like primary and secondary metabolites such as alkaloids, flavonoids, terpenes, taxanes, glycosides, gums, oils, lignans, saponins, biomolecules, vitamins, minerals etc. play significant roles in either inhibiting cancer cell divisions through various pathways (Table 2). In addition to the chemically synthesized anticancer agents, several anticancer compounds with different modes of action have been extracted from different plant sources, such as *Taxus brevifolia* (Paclitaxel, docetaxel), *Catharanthus roseus* (Vinblastine, Vincristine), *Berberis amarensis* (Berbamine), *Aglaia foveolata* (Silvesterol), *Cephalotaxus* species (Homoharringtonine), *Maytenus serrata* (Maytansine), *Dysoxylum binectariferum* (Flavopiridol), *Podophyllum* species (Etoposide, teniposide), *Tabebuia abellanedae* (Beta lepachone).<sup>7</sup>

Sr. No.	Compound	Mechanism of action
1	Paclitaxel, Docetaxel	Stabilization of microtubules
2	Vinblastine, Vincristine	Inhibition of tubulin polymerization
3	Berbamine	Caspase-3 dependent apoptosis
4	Silvestrol	Triggers apoptosis/mitochondrial pathway
5	Homoharringtonine	Inhibition of protein synthesis
6	Maytansine	Inhibition of microtube assembly
7	Flavopiridol	Inhibition of cell cycle progression at G1 or G2 phase
8	Etoposide, Teniposide	Inhibition of topoisomerase II
9	Beta lepachone	Inhibition of topoisomerase I and II

**Table 2 : List of Commercially available Anti-cancer phyto-compounds and their role<sup>7</sup>**

In several studies for cancer therapeutics, the anticancer properties of plants have been targeted due to their wide availability and no toxicity. The number of plants worldwide continues to be actively researched, some of which showing promising results in cancer therapeutics. According to the World Health Organization (WHO), some nations still rely on plant-based treatment as their main source of medicine and developing nations are utilizing

the benefits of naturally sourced compounds for therapeutic purposes.<sup>8</sup> There are some plants having Indian origin (Table 3) are showing reproducible anticancer activity has been discussed in following section. The emphasis on these plants is because many of them are edible, regularly used by individuals so as such do not have any toxicity and additionally reveal anti-cancer activities in preclinical and clinical trials.

### ***Important Anticancer plants of India and their proven activities***

#### ***1. Ferula asafoetida Linn.***

**Family:** Umbelliferae

**Common name:** Hing

**Traditional use:** It is used as a spice in food as well as a digestive aid. Plant parts are used in some respiratory disorders like bronchitis, asthma, and cough and in some neural disorders. From root and rhizomes of this plant, gum resin is obtained which is used as antispasmodic, carminative, expectorant, laxative, and sedative.<sup>9</sup>

**Anti-cancer activity:** *F. asafoetida* has been widely used as health-promoting, food supplements, and medicine.<sup>10</sup> The responsible chemo preventing constituents present in asafoetida are alpha-pinene, alpha terpineol, diallyl-disulfide, ferulic acid, isopimpinellin, luteolin, umbelliferone, and vanillin.<sup>11</sup> Apart from the antitumor effect, *F. asafoetida* has shown decreased lung, liver, and kidney metastasis and also decrement in areas of necrosis in the tumor tissue respectively.<sup>12</sup> The treatment of asafoetida has been shown to be effective in decreasing the tumor weight and tumor volume in treated mice.<sup>12</sup> Some reports showed that asafoetida has significant antioxidant and lipoxygenase inhibitory activity.<sup>13</sup>

#### ***2. Berberis vulgaris L.***

**Family:** Berberidaceae

**Common name:** Barberry

**Traditional use:** Used to treat fever, liver diseases, hyperglycemia, cough and bleeding.<sup>14</sup> The aqueous extract of dried fruits is used to treat acne.<sup>15</sup> Fruits are preferably given to diabetic person.

**Anti-cancer activity:** Scientific reports have shown that even at only 1 mg/ml concentration of *B. vulgaris*, the crude extract was effective while 9 mg/ml and 12 mg/ml of extract had better anti-cancer activity compared with doxorubicin in MCF-7 cell line however further

scientific validation is still not done.<sup>16</sup> One study evaluated the antioxidant and anti-cancer activity of ethanolic and ethyl acetate extract of root bark of *B. vulgaris* which shows the highest activity in ethanol extract, because of its large cytotoxic activity against the MCF-7 cell line unlike the ethyl acetate extract due to presence of several principal molecules including jatrorrhizine, palmatine, columbamine, berberine, and epiberberine.<sup>17</sup> Berberine, a bioactive compound isolated from this plant plays a crucial role as an anti-cancer agent by inhibiting proliferation and inducing cell death associated with G0/G1 cell cycle arrest in cancerous cells.<sup>18</sup> This bio-active compound also induces apoptotic cell death in human epidermoid carcinoma cells A431 through activation of the caspase-3 pathway and the distraction of mitochondrial membrane potential.<sup>19</sup>

### **3. *Acacia catechu* Linn.**

**Family:** Mimosaceae

**Common name:** Kattha

**Traditional use:** Used to treat blood clotting, gingivitis, swelling in liver, skin disorder, constipation and chest pain and for birth control.<sup>20</sup>

**Anti-cancer activity:** The abundant amount of polyphenolic and flavonoid compounds is found in the aqueous extract of *A. catechu*.<sup>21</sup> The antiproliferative activity of methanolic extract of *A. catechu* studied in different cell lines was found in decreasing order as Hep-G2 > MCF-7 > IMR32 > HeLa = A549.<sup>20</sup> It has been reported that 70% methanolic extract of “Katha” leads to apoptosis induction by increasing the Bax/Bcl-2 ratio which results in the intrinsic pathway, i.e. activation of caspase-cascade and ultimately leads to the cleavage of Poly adeno ribose polymerase (PARP) in MCF-7 cell line.<sup>22</sup> *A. catechu* ethanolic bark extract is useful as a therapeutic agent for the attenuation of oral squamous cell carcinoma.<sup>23</sup>

### **4. *Ficus racemosa* Roxb.**

**Family:** Moraceae

**Common name:** Gular

**Traditional use:** Used to treat diabetes, hemorrhoids, inflammation, and urinary diseases.<sup>24</sup>

**Anti-cancer activity:** The methanolic extract of *F. racemosa* fruit has shown promising anticancer properties against human hepatocellular carcinoma (HepG-2) cells proven by comet assay and DNA fragmentation assay but this requires further scientific validation is

remaining.<sup>25</sup> On the basis of Sulphorodamine B (SRB) assay, the fruit extract of *F. racemosa* has shown cytotoxic and anti-cancer activity in MCF-7 cell line at  $\geq 80 \mu\text{g/ml}$  concentration.<sup>26</sup>

### **5. *Cyperus rotundus L.***

**Family:** Cyperaceae

**Common name:** Nutgrass

**Traditional use:** Used to treat gastric disorders, malaria, inflammation, diarrhea, diabetes.<sup>27</sup>

**Anti-cancer activity:** Reports show that the n-hexane fraction of *C. rotundus* rhizome has anticancer activity against breast cancer cell line MCF-7 arresting cells in the G<sub>0</sub>-G<sub>1</sub> phase through induction of apoptosis.<sup>28</sup> In human colon cancer cell line (HCT116) and Ehrlich Ascites Carcinoma (EAC) cell lines, ethanolic extract of *C. rotundus* rhizome has highest cytotoxic effect when compared to traditionally used drug doxorubicin.<sup>29</sup>

### **6. *Tinospora cordifolia (Willd.) Miers***

**Family:** Menispermaceae

**Common name:** Guduchi

**Traditional use:** Used to treat diabetes, cholesterol, hay fever, lymphoma, rheumatoid arthritis (RA), hepatitis, peptic ulcer disease (PUD), gonorrhea, syphilis. It is also used for some common health problems like stomach pain, allergy and fever.<sup>30</sup>

**Anti-cancer activity:** The hexane extract of *T. cordifolia* has been reported to inhibit cell proliferation, cell differentiation, and the activity of tumor-associated macrophage in Ehrlich ascites tumor (EAT) in mice and also known to induce apoptosis via caspase-3 DNase induced apoptosis.<sup>31</sup> Alkaloids isolated from *T. cordifolia* extracts have better antineoplastic activity than compared to doxorubicin treatment.<sup>32</sup> It is reported that *T. cordifolia* also has ROS mediated pro-apoptotic effects in breast cancer cells.<sup>33,34</sup>

### **7. *Zizyphus mauritiana Lamk.***

**Family:** Rhamnaceae

**Common name:** Indian jujube

**Traditional use:** Used for improving hair growth, muscular strength, weight and wound healing. Used for preventing liver and bladder diseases, bacterial infection, obesity and

**stress ulcers. It is also used to reduce constipation, asthma, fever, and to reduce symptoms of some medications.**<sup>35</sup>

**Anti-cancer activity:** Fruit, leaves and seed extracts of *Z. mauritiana* have been reported to have antioxidant activity and bark and pulp are reported to possess cytotoxic action against cancer cell lines.<sup>36-42</sup> Ethanolic-aqueous seed extracts of *Z. mauritiana* depict the anti-tumor and cytotoxic potential in Human promyelocytic leukaemia cells (HL-60), Human promyelocytic leukaemia cells (Molt-4) and human cervical cancer cells (HeLa).<sup>43</sup>

### **8. *Boswellia serrata* Roxb. ex Colebr.**

**Family:** Burseraceae

**Common name:** Salai guggal

**Traditional use:** Gum resin extract is used for chronic inflammatory diseases. Different plant parts are used for diarrhea, dysentery, ringworm, boils, fevers (antipyretic), skin and blood diseases, cardiovascular diseases, mouth sores, bad throat, bronchitis, asthma, cough, vaginal discharges, hair-loss, jaundice, hemorrhoids, syphilitic diseases, irregular menses and stimulation of liver.<sup>44</sup>

**Anti-cancer activity:** Methanolic extract of *B. serrata* shows apoptotic activity in human colon cancer cells (HT-29) by targeting microsomal prostaglandin E synthase-1 of mPGES-1/PGE2 pathway in which extracts inhibits mPGES-1 and decrease the PGE2 level and its downstream targets.<sup>45</sup> The biologically active constituent of boswellia gum resin is boswellic acid. Some reports have shown that boswellic acid has anti-inflammatory and anti-cancer properties.<sup>46, 47</sup> No adverse effect of this plant has been reported yet.

### **9. *Psoralea corylifolia* Linn.**

**Family:** Fabaceae

**Common name:** Babchi

**Traditional use:** Used to treat skin disorders, hair treatments. Used to treat bronchial asthma and cough, anemia and edema. Fruits are used to treat inflammatory disease and leaves are used for diarrhea.<sup>48</sup>

**Anti-cancer activity:** Seed extract of *P. corylifolia* has been reported to have anticancer activity in MCF-7 cell line by increasing apoptotic cell death.<sup>49</sup> Further scientific validations of this plant remain to be studied.

**10. *Pulicaria wightiana* L.****Family:** Asteraceae**Common name:** Sontikli**Traditional use:** The leaf extract is used to treat fever and rheumatism.<sup>50</sup>**Anti-cancer activity:** The essential oil of *P. wightiana* has anti-cancer property as indicated by *in vitro* cell growth inhibition and morphological changes in MCF-7 cells.<sup>51</sup> However further investigations are required to understand its exact mechanism of action.**11. *Elephantopus scaber* Linn.****Family:** Asteraceae**Common name:** Gobhi**Traditional use:** Different plant parts are used as an astringent agent, cardiac tonic, and diuretic, and is used for eczema, rheumatism, fever, and bladder stones, nephritis, edema, dampness, chest pain, pneumonia, scabies and leukemia.<sup>52</sup>**Anti-cancer activity:** *E. scaber* contains anti-cancer bioactive compounds. The chloroform extract of *E. scaber* leaf shows highest cytotoxic activity in T47D cells than methanolic and ethanolic extracts.<sup>53</sup> The ethanolic extracts has cell growth inhibition effect in sub G<sub>1</sub> phase.<sup>53</sup> The dichloromethane fraction of *E. scaber* has anti-cancer property through apoptotic induction in HeLa, A549, MCF-7, and Caco-2 cell lines.<sup>54</sup>**12. *Tecomella undulata* (Sm.) Seem.****Family:** Bignoniaceae**Common name:** Roheda**Traditional use:** The bark obtained from the stem is used as a remedy for syphilis. It is also used in curing urinary disorders, enlargement of spleen, gonorrhoea, leucoderma and liver diseases. Seeds are used against abscess. The plant is used to cure leucorrhoea, leucoderma, enlargement of spleen, traumatic wounds, hepatitis, piles, anorexia, flatulence, tumors, worm infestations and syphilis.<sup>55</sup>**Anti-cancer activity:** The chloroform fraction of bark extract indicated apoptosis in chronic myeloid leukemia cell line (K562).<sup>55</sup> Quercetin (0.03%) has been reported in the bark extract which is proven an anti-cancer bioactive compound.<sup>55</sup> Further studies are required for insight to its anticancer properties.

Name of Plant	Distribution in India
<i>Ferula asafoetida Linn.</i>	Kashmir and some parts of Punjab
<i>Berberis vulgaris L.</i>	Uttarakhand
<i>Acacia catechu Linn.</i>	Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh, Gujarat, Madhya Pradesh, Uttar Pradesh and Rajasthan
<i>Ficus racemosa Roxb.</i>	Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Sikkim, Meghalaya, W. Bengal
<i>Cyperus rotundus L.</i>	Throughout India
<i>Tinospora cordifolia</i> (Willd.) Miers	Throughout India
<i>Zizyphus mauritiana</i> Lamk.	Throughout India except Jammu & Kashmir, Himachal Pradesh, Sikkim, Arunachal Pradesh.
<i>Boswellia serrata</i> Roxb. ex Colebr.	Assam, Bihar, Maharashtra, Odisha, Punjab, Rajasthan
<i>Psoralea corylifolia</i> Linn.	Central India and Eastern part of Rajasthan, Punjab, and adjoining areas of Uttar Pradesh.
<i>Pulicaria wightiana</i> L.	Karnataka, Tamil Nadu
<i>Elephantopus scaber</i> Linn.	Assam, Meghalaya, Odisha, Uttar Pradesh
<i>Tecomella undulata</i> (Sm.) Seem.	North-West region of India

**Table 3: Plants distribution in India**<sup>56</sup>

### Current Research gaps

It is known since long time that secondary metabolites and the bio active compounds play crucial role in phytotherapeutics. However, the scientific validation of many of these compounds are yet pending. Most of the studies done so far have mainly focus on single plant extract or poly herbal extract. There are very few studies that have used combinational approach which remains an unexplored area as of now. Scientists have been more focused on the efficacy without efficient and in-depth toxicity profiling of plant derived compounds. It has been reported that the ecological parameters affect the composition and activity of secondary metabolites in plants<sup>57</sup> which indicates it is better to do toxicity study for a particular plant sample and then go for therapeutic study. Heavy metals like Pb, Cd, Hg, Cr

etc. interfere the drug delivery during *in vivo* studies.<sup>58</sup> So it's necessary to evaluate the different types of toxicity parameters to confirm the safety of natural therapeutic compounds. This part of the study reference to phyto-formulation is also an avenue for further research and investigation.

## **Future Direction**

In the fields of Cancer therapeutic research, medicinal plants are gaining significance. Treatment of cancer by use of natural products and traditional medicine by applying the concepts of Ayurvedic formulations is attaining a great significance scope of cancer research. In some plants, the scientific validation and clinical trials are still remaining for their anti-cancer activity which gives discernments for therapeutic research. Also there are currently developments using new technologies such as nanoparticles to be used in administration of anticancer compounds and therapies. Their development could be applied for better drug availability to the specific tissues and help in aims to reduce severe side effects of treatments. The bioactive phyto-compounds and their biological activities mentioned in this review can help researchers to explore these plants for further studies.

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# Cognitivist Lesson Plans: A Tool for Effective Teaching for Mathematics Teachers

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## Abstract

Effective teaching of School mathematics has always been an area of concern. Although the B.Ed. curriculum includes sufficient elements in order to train mathematics teachers, but most of the models, methods and approaches that are taught, are done as separate entities and lack a complete, connected, logically arranged mechanism to integrate subject and content-specific requirements with mathematical thinking skills. An Action research is conducted to resolve the above stated problem with B.Ed. student-teachers (who have opted for Mathematics subject as an elective) of the Navrachana University. The solution is presented as a ‘Cognitivist Lesson Plan’ format, which is executed and the result is then reflected upon for further action or modification.

## Key words

Mathematics Education, Mathematical thinking skills, Cognitivist Lesson Plans

## Introduction

The present paper is a report of an Action research conducted by the Author, who is a mathematics teacher-educator in the B.Ed. program of the Navrachana University, Vadodara, Gujarat, India. ‘Mathematics Pedagogy’ is one of the courses that is offered to the Science and the Math graduates and post graduates enrolled in the B.Ed. program. One of the important contents of this course is ‘Preparing Lesson plans’ on topics of school mathematics. In order to bring about specific changes in this area, so that student-teachers gain more efficiency in preparing Lesson plans that fulfill the subject requirement as well as they understand and integrate mechanisms to

promote mathematical thinking through their Lessons, the Author followed the following steps that align to an Action research.

“Action research is done in order to create knowledge, which is based on explorations done within specific and often practical settings. The drive of action research is to help the researcher learn through action conducted, that can lead further development of knowledge in the target area”<sup>1</sup>. “Reason and Bradbury (2006) describe action research as an approach which is used in designing studies which seek both to inform and influence practice”<sup>2</sup>. Sagor (2000)<sup>1</sup> in his book on Action Research, provided seven steps to be followed to conduct an Action research. The Study further is reported in accordance to those steps.

### **Step 1: Selecting a Focus**

The need to focus on thinking have never been so urgent or predominantly looked for until the present era. Education systems throughout the world have been striving to refurbish this need, which is apparent from their policies, frameworks, curricula<sup>3,4,5, 6,7,8</sup>. Jean Piaget and many other prominent psychologists like Erickson, Bruner, and Berlyne adhere to the fact that rightful thinking need to be taught by presenting appropriate experiences. The different subjects taught in schools thus are created to deliberate this goal.

Mathematics as a subject enjoys supremacy with respect to its ingrained ability to initiate, involve and award its seekers with analytical, critical and creative thinking. Mathematics educators get an added advantage on this, with myriad scopes overtly and covertly integrated within the contents they teach. Inspite of this advantage, there are very few mathematics teachers who are able to develop mathematical thinking among their students. This is due to their strong adherence to the transaction of procedural knowledge needed to solve a mathematical problem in a fixed, defined context. Mathematical thinking, in particular, means not just solving math problems but to see the number, or the symbol, formula, equation, or the statement with its realistic meaning; to understand the underlying relationships, see the patterns and make conjectures; use varied mathematical and established facts to make new conjectures.

Thus the major focus of the Author was to understand the concept of ‘Thinking’ in more depth; relating the same to the Mathematics subject –related requirements and presenting that as a proper structure to the student-teachers.

### **Step 2: Clarifying Theories**

There are many learning theories, taxonomies and frameworks guiding educators to identify, design, and implement instructions that aim to develop mathematical thinking among students. In the present paper, the author studied the ‘thinking processes and skills’<sup>9, 10</sup> and then attempted to integrate the learnings to develop Lesson Plans for mathematics teaching, terming the same as ‘Cognitivist Lesson Plans’.

- ***Concept of ‘Thinking’ with respect to Bloom’s Revised Taxonomy and Marzano et al.***

Both the stated Studies have explained ‘thinking’ in terms of ‘thinking processes’ and ‘thinking skills’. The same is tabulated below and explained in paragraphs ahead.

Cognitive Processes	Sub Categories	Types of Knowledge used in cognition
Remember	Recognizing, recalling	<i>Factual Knowledge</i>
Understand	Interpreting, exemplifying, classifying, summarizing, inferring, comparing, explaining	<i>Conceptual Knowledge</i>
Apply	Executing, implementing	<i>Procedural Knowledge</i>
Analyze	Differentiating, organizing, attributing	<i>Metacognitive Knowledge</i>
Evaluate	Checking, critiquing	
Create	Generating, planning, producing	

**Table 1: Bloom’s Revised Taxonomy<sup>9</sup>**

Thinking Processes (p 32)	Thinking Skills (p 68)
<i>Concept formation</i>	Focusing skills (defining problem, setting goals)
<i>Principle formation</i>	Remembering (encoding, recalling)
<i>Comprehension</i>	Organizing (comparing, classifying, ordering, representing)
<i>Problem Solving</i>	Analyzing (identifying components, relationships & patterns, main ideas and errors)
<i>Decision Making</i>	Generating (inferring)
<i>Research</i>	Integrating (consolidating)
<i>Composition</i>	Evaluating (establishing criteria, verifying)

**Table 2: Marzano et al. ‘Thinking Processes & Skills’<sup>10</sup>**

Bloom’s “Cognitive processes with its Sub-categories” and Marzano’s “Thinking skills” as shown in Table 1 and 2, can be considered to be micro skills or “simpler cognitive operations” required in the development of Marzano’s “Thinking processes” as in Table 2 and Bloom’s “Knowledge types” as in Table1. The “Thinking skills and the Cognitive processes” can be

considered as the means or tools used to achieve the outcome or product termed as “*Thinking processes*” by Marzano et. al and “*Knowledge types*” by Bloom.

Thus, while planning a Lesson, if the “*Thinking processes*” or the “*Knowledge types*” are considered as the ‘learning outcomes’ of the Lesson, then it would be easier for teachers to engage their students with the above referred “Thinking skills” during the instructional as well as the assessment phase. So, in order to design mathematical instruction that aims to promote mathematical thinking among students, some of the “*Thinking processes*” and the “*Knowledge types*” as enlisted in Table 1 and 2 have been used to create a flexible framework for teaching mathematics in the present Paper ahead. In doing so, the specific subject-related requirement is also needed to be taken care of.

To design effective instruction in mathematics, educators and policy makers emphasize on the transaction of ‘conceptual knowledge’ and associated ‘procedural knowledge’ for effective problem solving. Conceptual knowledge of a content enables problem solvers to use higher cognitive skills and apply appropriate or discover new procedures to solve the mathematical problem.“The National Research Council and NCTM declared a student to be mathematically proficient, if he possesses:Conceptual understanding, Procedural fluency, Strategic competence, Adaptive reasoning, and Productive disposition”<sup>11</sup>.

Thus, keeping the above requirements for effective teaching-learning in mathematics, let us focus on the concept of Lesson Planning.

- ***Lesson Planning in Mathematics***

“L.B. Stands defines a Lesson plan as ‘Plan of Action’ executed by a teacher to teach a specific topic”<sup>12</sup>. Depending upon the requirement of the topic to be taught, teacher uses different approaches to teach, which is recorded in specific formats for unanimity. One of the most prevalent type of Lesson plan format that is followed in the teacher community and is also a part of the B.Ed. curriculum is the Herbartian Lesson Plans which includes five steps besides the General and the Specific Objectives. They are “1. Introduction, 2. Presentation, 3. Comparison and Association,4. Generalization, 5. Application”<sup>13</sup>. These plans support traditional form of teacher centred teaching and is proved not to be much effective in developing thinking skills in students. Lesson plan that support an extreme opposite, i.e. student centred approach of teaching, widespread in education is the Constructivist approach. In this, teacher provides learning experiences to students, in form of activities, manipulatives, case studies, etc. and then uses scaffolding to guide the students to

discover the learning on their own<sup>14</sup>. There are different formats and models that are used to make Constructivist lesson plans.

Different methods of teaching mathematics like the Analytical and synthetic method; Inductive and deductive method; Heuristic method, Problem-solving method, Project method are taught to the B.Ed. students in Navrachana University, Vadodara along with the Herbartian and the Constructivism Lesson plans. But each are taught as separate entities; what was required was a common Lesson plan format that fulfills the requirement of effective mathematics teaching - ingrained with opportunities to develop mathematical thinking in students and includes the positives of all the above mentioned approaches and methods.

In order to fulfill this requirement, the Author integrated the required approaches of teaching mathematics along with the thinking processes and skills as indicated by Bloom and Marzano et al., and created a Lesson Plan format and termed that as Cognitivist Lesson Plans.

- ***Cognitivist Lesson Plan Format***

Learning outcomes for a specific sub-topic in mathematics is expected in the following 5 areas:

***1. Transaction of the Math Content needs to be done to deliver the (Conceptual Knowledge in realistic and mathematical forms):***

- Conceptual Meaning: Realistic understanding of the Math content
- Mathematical Reasoning: Connecting the realistic understanding to the mathematical understanding with proper reasoning
- Mathematical Representation: Clearly stating or consolidating the mathematical formula or definition or characteristics of the target sub-topic

***2. Related Computations need to be clearly explained in terms of the (Procedural knowledge):***

- Algorithmic Processes: Explanation of the steps required to solve a mathematical problem
- Variable Methods: Showing or allowing students to explore different theoretical and mental methods to find the solution
- Calculations: Clear explanation of the required calculations and the probable errors while applying different mathematical operations

***3. Applications of the Concept and the Computations need to be in the form of:***

Simple Problems with known contexts

- Interpretation of mathematical language
- Conversion to mathematical representation

- Computation
- Verification

#### **4. Advanced Applications:**

Problems with unknown contexts or challenging situations related to the specific content

#### **5. Through-out the transaction, development of the following Cognitive skills:**

- Basic Cognitive skills like focusing, recalling, organizing, representing, computing, visualizing, estimating, generalizing etc. –*Transacted while executing instructions to achieve Learning outcomes 1 and 2.*
- Higher Cognitive skills like analyzing, synthesizing, evaluating, creating – *Transacted while executing instructions to achieve Learning outcomes 3 and 4.*

#### **Step 3: Identifying Research Questions**

Development of the Cognitivist Lesson plan was not enough, its effectiveness, in terms of the ability of teachers to make such Plans, was needed to be checked. Thus, the Action research was conducted to check out :

1. The extent to which Cognitivist Lesson planning is understood by the pre-service mathematics student-teachers.
2. The extent to which mathematics student-teachers are able to make the Cognitivist Lesson plans.

#### **Step 4: Collecting Data**

The data was collected from a sample of seventeen First Year (second semester) B.Ed. student-teachers of the 2019-21 batch of the Navrachana University, Vadodara, Gujarat, India. These students have ‘Mathematics Method’ as one of their elective subjects for the first three semesters in the B.Ed. program. Five of the student-teachers had Mathematics as their major subject in graduation/post-graduation; while the remaining twelve students had Science (Biology, Physics and Chemistry) as their major subject.

The author developed five sample Lesson Plans on the topic ‘Percentage’ and implemented those lessons on the Sample student-teachers. She took seven sessions of 1 hour each to demonstrate the Lessons and teach the ‘cognitivist format’ to the sample student-teachers. Students-teachers were then given out a few math topics and a time of two weeks to make detailed

‘Cognitivist lesson Plans’ for one topic. The submissions made were then evaluated with the help of the Rubric designed by the Author (attached in Appendix).

### **Step 5: Analyzing Data**

The detailed Cognitivist lesson plans of all seventeen student-teachers were scrutinized with respect to the Expected Learning Outcomes (as in Table 3) using two ranges – Supreme to Moderate and Minimum to Absent. The ranges indicate the quality of the ‘Instructional Processes’ used in each Lesson Plan. Points accordingly was awarded in terms of Supreme – 3; Moderate – 2; Minimum – 1; and Absent – 0. Then number of students falling in the first range (Supreme-Moderate) and second range (Minimum-Absent) was counted and converted into percentage. These details are tabulated in the Table 3.

<b>Learning Outcomes</b>	<b>Instructional Processes to be used provide</b>	<b>% of student-teachers made Lesson Plans of the quality in the Range of-</b>	
		<b>Supreme-Moderate</b>	<b>Minimum-Absent</b>
1. Content transaction	Conceptual Meaning	53%	47%
	Mathematical Reasoning	41%	59%
	Mathematical Representation	65%	35%
2. Computations	Algorithmic Process	53%	47%
	Variable Methods	41%	59%
	Calculations	35%	65%
3. Simple Applications	Appropriate Problems	47%	53%
	Explanation	24%	76%
4. Advanced Applications	Appropriate	23%	77%
5. Core Thinking Skills	Basic	65%	35%
	Higher	18%	82%

**Table 3: Quantum of student-teachers and the quality of ‘Cognitivist lesson Plans’**

### **Step 6: Reporting Results**

The outcome of the Treatment can be interpreted as follows:

#### ***Learning Outcome 1 – Content Transaction***

Around 53% of the student-teachers could plan the content transaction by conveying the realistic concept or the conceptual meaning of the math topic quite satisfactorily, that is in the range of supreme-moderate.

Around 41% of the student-teachers could provide appropriate explanations or mathematical reasoning to help students make the connection between the ‘concept’ to its mathematical representation.

Around 65% of the student-teachers could clearly consolidate or state the mathematical representation of the math fact or content being transacted.

#### ***Learning Outcome 2 – Computations***

Around 53% of the student-teachers could satisfactorily show all the algorithmic processes involved in the content to be transacted, and thus lie in the range of supreme-moderate.

Around 41% of the student-teachers showed the variable methods that can be used to reach solutions either in algorithms or in calculations.

Around 35% of the student-teachers thought it necessary to give proper explanations for the calculations involved while solving numerical problems.

#### ***Learning Outcome 3– Simple Applications***

Around 47% of the student-teachers felt the need to assess the concept formation and the associated math computations with help of simple applications like direct word problems or contextual real life problems. They enlisted appropriate problems that would help strengthen the math content being taught in their Lesson Plans.

Around 24% of the student-teachers provided appropriate explanations of the Simple Problems enumerated in the Lesson Plans.

#### ***Learning Outcome 4 - Advanced Applications***

Around 23% of the student-teachers included appropriate complex or higher level problems related to the math content in their Lesson Plans.

#### ***Learning Outcome5 - Core Thinking Skills***

Around 65% of the student-teachers integrated instructions in the supreme-moderate range, that allowed students to exercise basic thinking skills like focusing, recalling, organizing, estimating, visualizing, verifying, generalizing in their Lesson Plans.

Around 18% of the student-teachers could provide opportunities to students to analyze, synthesize, evaluate, create in their Lesson Plans satisfactorily.

The above analysis is explained through a Sample student-teacher's LP in Appendix 2.

### **Step 7: Taking informed actions**

The analyzed data proves that more than fifty per cent of the student-teachers have understood and have satisfactorily prepared the Cognitivist Lesson Plans on different Math topics of the quality that can be termed as Supreme to Moderate.

Holistically, if we view the results, as well as while observing the student-teachers working with the Lesson plans, a lot of improved actions become imperative, which are as follows;

- Student-teachers have developed a proper understanding about conceptual knowledge and procedural knowledge and are at ease in delivering each for respective known and explored Math topics, but they mainly struggle to make the connections between both. They struggle to integrate mathematical reasoning while presenting the conceptual part and converting that to respective mathematical representation.
- Separate sessions highlighting on -(a) identification of probable errors done by school students in different Math topics (b) use of variable methods to solve a math problem (c) mental math strategies - have to be taken up to fill up the discrepancy here.
- In case of Application related section, where student-teachers had to list out appropriate word problems related to the math topic being taught and also pen down their explanations in detail. The variety, the ascending difficulty level and the explanations mattered. Many student-teachers did not provide explanations. There were a few student-teachers who completely missed out the advanced level problems or higher level tasks in their Lesson plans. Thus, the final score came out less. It was due to not lack of efficiency but may be lack of will.
- Student-teachers got a proper idea regarding the different Thinking Skills but struggled to consciously integrate the same in their Lessons.
- More rigor and time is needed in the transaction of this methodology by the teacher-educator and more practice, ability and desire is needed in the part of the student-teacher for better results.
- This format will be more applicable to in-service mathematics teachers, who have a better understanding of the subject, student abilities, curricular limitations and much stronger foundation in school mathematics.

## Conclusion

It is a well promoted fact that constructivist methodologies align very well with Thinking Skills; while Traditional modes of teaching hardly cater to the same. Cognitivist Lesson plans includes the advantage of both can be a better alternative to practice in mathematics classrooms. Teaching of the same at the B.Ed. level and allowing practice of the same during Internships would help create a bunch of mathematics teachers who could disseminate good quality mathematics teaching, especially in Indian classrooms with more density where constructivist pedagogies cannot work well. These Cognitivist Lesson plans can also be converted into Self-Learning materials and be used for online teaching.

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## APPENDIX 1

### 1. Rubric to check the effective use of the Cognitivist Lesson Plan Format

Sr. No.	1. Content transaction			2. Computations			Direct Problems		Advanced Problems	Cognitive Skills	
	Concept (3 – 0)	Math Reasoning (3 – 0)	Math Representation(3 – 0)	Algorithms (3 – 0)	Variable Methods (3 – 0)	Calculations (3 – 0)	Appropriate (3 – 0)	Explanation (3 – 0)	(3 – 0)	Basic (3–0)	Higher (3 – 0)
1											
2											
3											
4											
5											
6											
7											
8											
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10											
11											
12											
13											
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15											
16											
17											

## APPENDIX 2

### COGNITIVIST LESSON PLAN MADE BY STUDENT-TEACHER 1 (LP 1)

**Topic: Profit % and Loss % Class: VII**

#### Main Teaching Points:

1. Content transaction using realistic conceptual understanding, mathematical reasoning and representations
2. Mental calculations
3. Procedural calculations
4. Simple application of computations

5. Simple problem solving
6. Advanced level problem solving

### **Teaching Plan for Main Teaching Point 1:**

- **Previous Knowledge:** Students already know the concept Cost Price, Selling Price, Profit, Loss and the relationship among them. The concept of Percentage and Unitary method.
- **Media/Material:** Black board, class set- up with desks and benches, currency notes prepared by students
- **Teaching Method:** Heuristic method
- **Teaching approach:** Inductive-Deductive
- **Specific Objective:**

Students will be able to explain the realistic concept Profit % and Loss %.

Students will be able to establish the mathematical reasoning behind calculation for Profit% and Loss%

Students will be able to induce the formula of Profit% and Loss%.

### **Teacher & Student Activity:**

1. **Development of the Realistic Concept, use of mathematical reasoning and emphasizing the mathematical language**

*[Previous day, five students were instructed by the teacher to make currency notes of Rs. 10, Rs. 50 and Rs. 100 (at least 5 of each) and to bring a specific number of day-to-day items with tags of 10, 50 and 100 on each item. A script was given to the five students (Rahul and Disha act as Retailers and the rest as Customers)]*

**T:** Good Morning students!

**S:** Good Morning Madam!

**T:** Follow my instructions to learn from the Role Play that will be conducted by us today. You can see three counters set up in front of the class. Counter 1 is tagged as ‘Wholesaler’, which is my counter. Rahul is the owner of the Counter 2; Disha is the owner of Counter 3. Rahul and Disha, both are ‘Retailers’ and Amit, Radha and Puja are ‘Customers’ who can buy items from the Retailers.

*[Focusing skill]*

Observe and note down the transactions of money that is happening between us during the entire Role Play. You will be asked a set of questions ahead.

### **Role Play:**

Rahul comes to the Teacher and buys some items worth Rs. 2000 from the Teacher. Then Disha comes and buys some items from the Teacher worth Rs. 1000. Before arranging the items on their Counters, both Rahul and Disha changes the price tags on each items they got. Every Rs. 10 tag is replaced by Rs. 20 tag; Rs. 50 tag by Rs. 70 and every Rs. 100 tag by Rs. 130 tag.

Now Amit comes to Rahul and buys some items for which he is charged Rs. 800; Radha buys some items and had to pay Rs. 1000 and Puja did a purchase of Rs. 700.

Teacher instructs the students to record the total purchase done from Rahul.

In the next scene, Amit, Radha and Puja purchase items of Rs. 500 each.

The Role Play ends here.

#### *[Visualizing skill]*

**Teacher goes ahead with a Question-Answer session, where mathematical reasoning is used to relate the realistic concept with mathematical terms/language**

**T:** In the first transaction between Wholesaler and Retailer, how what was the money transaction done by Rahul and Disha from the Wholesaler? And mathematically, which specific financial term will be used for the purchase done by Rahul and Disha?

**S:** Rahul buys items of Rs. 2000 and Disha buys items of Rs. 1000.

**T:** Since, they buy the items what terms will be used for the purchase done by them?

**S:** Cost Price

#### *[Recalling, Representing skill]*

**T:** Yes, very good. So for Rahul, the CP is Rs. 2000 and for Disha, CP is Rs. 1000.

**T:** What was the intention behind changing the price tags before selling their items to Customers?

**S:** Earning profit.

**T:** The Customers in Rahul's shop made a total purchase of how much?

**S:** Rs.  $(800 + 1000 + 700) = \text{Rs. } 2500$

**T:** So, with respect to Rahul, the Retailer, what statement can be made for this transaction?

**S:** Rahul sold goods worth for Rs. 2500.

**T:** Very good. So, what should be the mathematical term used instead of the above statement for Rahul's sale?

**S:** For Rahul, the Selling Price or SP is Rs. 2,500.

**T:** And when you apply the same for Disha, what is it?

#### *[Organizing skill]*

**S:** For Disha, the Selling Price or SP is Rs. 1,500.

**T:** Now check with Rahul's CP and SP, and also of Disha's CP and SP. What gets revealed?

**S:** Both earn the same Profit of Rs. 500.

**T:** Very Good! But, what do you think, both will be equally happy with their dealings? Although the Profit amount is same, do they have the equal stand, when their CPs are not same?

**S:** We do not know madam.

**T:** Like in case of your marks, let me give an example – You have scored 20 out of 30 in Hindi and 40 out of 50 in English. What do you do to find out your performance was actually good in which subject?

**S:** We find percentage.

**T:** Right, the same can be done in Rahul's and Disha's case to check their performance.

## **2. Use of Mathematical reasoning to establish the Formula or the Mathematical representation**

**T:** So, we need to find the percentage of what, to check Rahul's performance?

**S:** Profit

**T:** How do we find the percentage of Profit Rahul made?

**S:** We don't know.

**T:** Use the same Marks example. You can try the Unitary method, where you have to calculate your marks out of 100.

**S:** For Hindi, out of 30, I get 20....so out of 100, I get?

$$\% \text{ of marks in Hindi} = \frac{20}{30} \times 100 = 66.6\%$$

*[Computing skill]*

**T:** Use the same reasoning in case of Rahul to find his Profit %.

**S:** His profit is Rs. 500, but out of how much?

**T:** Of course, he can earn only if he makes a proper investment, how much was that?

**S:** His CP, because he invested that Rs. 2000.

So, it will be- for Rs. 2000, he makes a profit of Rs. 500; then for Rs. 100, his profit will be?

$$\text{Rahul's Profit \%} = \frac{500}{2000} \times 100 = 25\%$$

**T:** Find the same for Disha.

$$\text{S: Disha's Profit \%} = \frac{500}{1000} \times 100 = 50\%$$

**T:** So what can you say now, on Rahul and Disha's status?

**S:** Disha's Profit % is more than Rahul.

**T:** Exactly, hope it is clear now that, only calculation of Profit, does not give us a real picture when we want to make comparisons. Companies need to compare their profits made with respect to previous years. Since, the initial CP or investment may not be same every year, the% profit or loss can give a better picture. There can be many such examples.

**T:** Now, see the calculation you did in Rahul and Disha's case using unitary method to calculate profit %. Can you come down with a Formula which can be directly used, when we know the initial investment or the CP and the Profit/Loss (or SP from which it can be calculated)?

$$\text{S: Profit \%} = \frac{\text{Profit}}{\text{CP}} \times 100$$

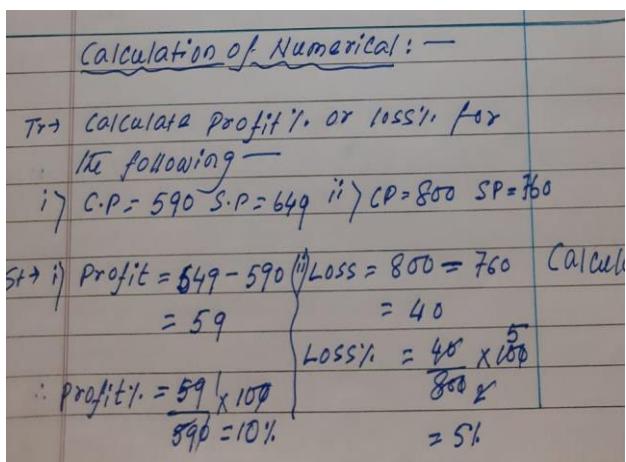
$$\text{Loss \%} = \frac{\text{Loss}}{\text{CP}} \times 100$$

*[Generalizing skill]*

#### Author's Feedback for Learning Outcome 1:

1. Conceptual meaning – the realistic understanding has been transacted impeccably. (Scored 3)
2. Mathematical Reasoning – Also integrated throughout excellently without any flaw (Scored 3)
3. Mathematical Representation – mathematical language well established and the final formula also induced well. (Scored 3)

Basic thinking skills: focusing, recalling, organizing, visualizing, verifying, generalizing skills have been taken care of. (Scored 3)



#### Author's feedback for Learning Outcome 2:

1. Algorithms – use of formula could be shown explicitly. (Scored 1)
2. Variable methods – Although not explicitly shown here, the application of unitary method to calculate % is shown in 1<sup>st</sup> segment. (Scored 2)
3. Calculations – decimal & fractional forms missing. (Scored 1)

Teacher & Student Activity		Skill used
<u>Similar looking Problems</u> —		
<u>Set-I</u> : —		
(i)	Shivanshi bought a sari for ₹ 2200 & sold it for ₹ 2420. Was there a profit/loss & what percent?	Comparison
(ii)	Shivanshi bought a sari for ₹ 2200 & sold it at 10% profit. What was the selling price of sari?	
<u>Set-II</u> : —		
(i)	Arnav bought a wristwatch for ₹ 900 & sold it at ₹ 810. Find the profit/loss percentage.	
(ii)	By selling a wrist watch at ₹ 810 Arnav made loss of 10%. Find its cost price.	

### Author's feedback for Learning Outcome 3:

1. Appropriateness of Simple Problems— The problems given are appropriate, fulfills the purpose of seeing relationships between the taught concept and simple real life applications. Also similar looking problems that require the use of higher focusing and analyzing skills are included (Scored 3)
2. Explanation – Not provided. (Scored 0)

Teacher & Student Activity		Skill used
<u>Advance Application</u> : —		
(i)	A Shopkeeper bought 120 sweets at ₹ 20 each. In his house 18 were consumed & he sold the remaining at ₹ 30 each. Find his profit/loss.	Mathematical Reasoning
(ii)	By selling a sofa for ₹ 10,240 Ronnie incurred a loss of 20%. If he wanted to make a profit of 6%, at which price should he have sold it?	

### Author's feedback for Learning Outcome 4 and 5:

1. Appropriateness of Advanced Problems— The problems given are appropriate. They will require the higher thinking skills of analyzing, synthesizing and evaluating (Scored 3)
2. A creative task could have been included for exercising the thinking skill of creating (Scored 0)

## **Awareness Regarding Plagiarism Amongst Post-Graduates and Faculty Paedodontists: An Online Questionnaire Survey**

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### **Abstract**

Good publication practices do not develop by chance, and will become established only if they are actively promoted. The incidence of plagiarism is alarmingly increasing; Researchers must have a thorough understanding of the publication ethics and copyright laws when preparing manuscript and presentations for publication on the Internet or journals. This paper reports the awareness regarding plagiarism amongst post graduates and faculty Paedodontist's for development of honest and scientific research. This was online questionnaire survey. E-mail ID of participants was obtained from ISPPD database. Results of this study showed that 77.3% participants thought that plagiarism occurred in publication only. They are not aware of consequences of copyright infringement. 33.6% agreed that short dead line for assignments as reason to plagiarise. This paper highlights the utmost important challenges and throws some light on awareness about copyright violation/infringement. Since it is the duty of academicians and researchers to keep a check on plagiarism and copyright infringement a thorough knowledge and awareness amongst Paedodontist's and researchers regarding the issue is needed.

## **Key words**

Copyright, Plagiarism, Electronic Mail, Surveys and Questionnaires, Publications, Faculty

## **Introduction**

Plagiarism is usually described as stealing and showing another's work as though it were one's own. Plagiarism relating to education and journalism is used in our field. Academic plagiarism includes: "The use of ideas, concepts, words or structures without adequately acknowledging the source to benefit in an environment where originality is expected".<sup>1</sup> Plagiarism by graduates, teachers, or scholars within academia is deemed to be intellectual dishonesty or intellectual fraud, and perpetrators are subject to academic censorship, up to and including expulsion. Several universities are using plagiarism identification tools to discover possible plagiarism and discourage plagiarizing students.<sup>2</sup>

The guidelines identify five levels of plagiarism that include the uncredited verbatim copying of a complete paper, or the verbatim copying of a major portion (> 50 percent, or 20% and 50%) or verbatim copying by the same author(s) within more than one paper, copying of individual elements (paragraph(s), sentence(s), illustration(s), etc.) resulting in a substantial portion (< 20 percent) of a paper inside. Lastly, it involves the paraphrasing of pages or paragraphs and copying of a substantial part of a text without specific delineation (e.g. quotes or indents).<sup>2</sup>

Self-plagiarism is the publication by the same author of a paper which is substantially identical to a published article, without recognizing the source and without seeking permission from the original copyright holder. There may be superfluous variations between the original and the second article, such as a new title or an updated abstract, but the data set and results remain the same.<sup>3-6</sup> Republication of a paper without permission and/or acknowledgment is a significant violation of publishing ethics because it infringes copyright, because in most cases the copyright of the paper rests with the journal and not with the authors; thus, the authors are not free to republish the paper and it distorts the scientific evidence.<sup>7,8</sup>

Plagiarism is regulated by Section 57 and Section 63 (a) of the Copyright Act, 1957. Pursuant to Article 57 of the Act, grant writers the right (special right) to assert authorship of their work. To detain or seek damages in respect of any alteration, fabrication, mutilation or other act relating to the said work performed prior to the expiry of the term of copyright where such act would be harmful to its honour or reputation Section 63 of the Act provides for

penalties for infringement of rights under this Act. The perpetrator is punishable with imprisonment. The definition can range from six months to three years for the offence. The lawbreaker may have to pay the money i.e. fine which can range from 50,000 rupees to two lakh rupees.

There are various organizations and committees all over the world which are working on curtailing and providing information regarding Publication ethics. One such committee is “Committee on Publication Ethics” (COPE) which works on ethical grounds, which aims to increase the authenticity of the published data. It also notes that in the budding researchers ethical culture needs to be created.<sup>2</sup>

Copyright infringement punishes the respective researcher depending on the laws made by different countries. Usually these cases are settled by direct arbitration, notice and dismissal process, or civil court litigation.<sup>2</sup>

Hence for, Good publishing practices don't grow by accident, and can only be developed if actively promoted. The awareness of plagiarism among postgraduates and faculty paedodontist's for the development of honest and scientific research therefore needs to be assessed. The goal of this study was to evaluate the knowledge among postgraduates and faculty paedodontist's about plagiarism through an online questionnaire survey.

## **Methodology**

The survey was conducted as Cross-sectional design. Email ids of post graduate students and faculty of paediatric dentistry were retrieved from ISPPD office. Post graduate students and faculty of paediatric and preventive dentistry who did not respond to the mail and didn't fill the questionnaire were excluded from the study.

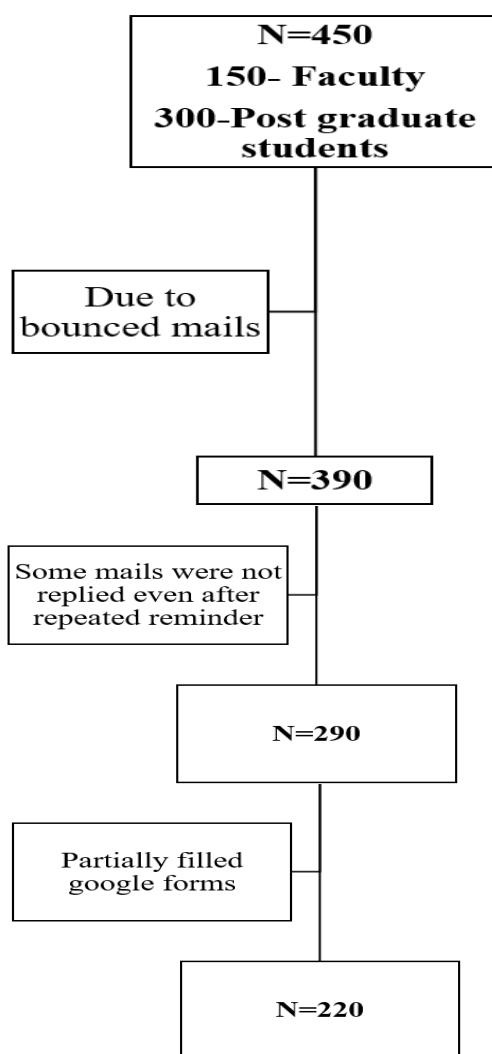
The questionnaire was prepared with the help of experts. Two types of validation were obtained namely concurrent and content validation. The questionnaire was also validated using unpaired t test. Here p-value is 0.405 and hence the answers of respondents and selected experts were almost similar. The overall reliability was about 89% (Cronbach's alpha = 0.887) Thus, statistically it was tested and proved good validity of it.

All the Postgraduate and Faculty members were approached by email to fill a questionnaire sent through [www.googleforms.com](http://www.googleforms.com). Following that, consecutively for three week repeated email were sent to urge them to respond to the electronic questionnaire to obtain the maximum response rate.

The Collected data was entered in Microsoft excel (2007) spreadsheet. Descriptive analysis was computed using excel statistical operations.

## Results

Total of 450 dental evaluators were contacted out of which final 220 complete responses were considered for data analysis as shown in figure 1.



**Figure 1: CONSORT flow diagram**

Table1 illustrates all the items of questionnaire tool with Yes/ No/Don't Know type of responses. These questions were purely based on knowledge of the participants regarding

plagiarism. Here, participants were asked about if they are confident enough to reference their work or about policies at institutional level.

Sr. no	Questions/Items	Yes N (%)	No N (%)	Sometime/Don't know/ some Idea N (%)
1.	Are you confident with referencing your work?	172 (78.2)	14 (6.3)	34 (15.5)
2.	Do you use words or sentences from articles or books when writing essays without using quotation marks?	54 (24.5)	106 (48.2)	60 (27.3)
3.	Does your institution have a plagiarism policy?	98 (44.5)	58 (26.4)	64 (29.1)
4.	Do you know what plagiarism detection system are being used in scientific community?	92 (41.8)	64 (29.1)	64 (29.1)
5.	Have you/anyone you know ever had been detected for plagiarism?	86 (39.1)	72 (32.7)	42 (19.1)
6.	Self-plagiarism is punishable as plagiarism.	64 (29.1)	38 (17.3)	118 (23.6)
7.	Are you aware of UGC guidelines?	48 (21.8)	108 (49.1)	64 (29.1)

**Table1: Questionnaire tool with Yes/ No/Don't Know type of responses.**

Table 2 illustrates that all the items of questionnaire tool with responses from strongly disagree to Strongly Agree. These questions illustrate the feelings of participants regarding authenticity of the plagiarism.

Sr. no	Questions/ Items	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1.	Sometimes I'm tempted to plagiarise, because everyone else is doing it (students,	92 (41.8)	58 (26.4)	38 (17.3)	28 (12.7)	4 (1.8)

	researchers).					
2.	Short deadlines tempt me to plagiarize a bit.	60 (27.3)	56 (25.5)	30 (13.6)	68 (30.9)	6 (2.7)
3.	Plagiarized parts of a paper may be ignored if the paper is of great scientific value.	60 (27.3)	64 (29.1)	42 (19.1)	40 (18.2)	14 (6.4)
4.	The names of the authors who plagiarize should be disclosed to the scientific community.	26 (11.8)	32 (14.5)	62 (28.2)	76 (34.5)	24 (10.9)
5.	Young researchers who are just learning the ropes should receive milder punishment for plagiarism.	16 (7.3)	38 (17.3)	36 (16.4)	110 (50.0)	20 (9.0)
6.	Sometimes I copy a sentence or two just to get inspiration for further writing.	28 (12.7)	46 (20.9)	36 (16.4)	102 (46.4)	8 (3.6)
7.	When I don't know what to write, I translate a part of a paper from a foreign language.	48 (21.8)	80 (36.4)	36 (16.4)	50 (22.7)	6 (2.7)
8.	It is justified to use previous descriptions of a method, because the method itself remains the same.	8 (3.6)	36 (16.4)	54 (24.5)	108 (49.1)	14 (6.4)
9.	Plagiarists do not belong to the scientific community.	30 (13.6)	80 (36.4)	70 (31.8)	32 (14.5)	8 (7.3)
10.	I could not write a scientific paper without plagiarizing.	66 (30.0)	92 (41.9)	32 (14.5)	30 (13.6)	0 (0.0)
11.	It is not so bad to plagiarise.	68 (30.9)	78 (35.5)	44 (20)	26 (11.8)	4 (3.6)

12.	I keep plagiarising because I haven't been caught yet.	108 (49.1)	72 (32.7)	26 (11.8)	10 (4.5)	4 (3.6)
13.	I required more information and knowledge regarding plagiarism and publication ethics	10 (4.5)	8 (7.3)	8 (7.3)	116 (52.7)	78 (35.5)

**Table 2: Questionnaire tool with responses from strongly disagree to Strongly Agree**

Table 3 illustrates that all the items of questionnaire tool with multiple responses. This table records the opinions of the Subjects related to the help post graduates can take from, percentage of plagiarism or the punishment given on doing plagiarism

Sr. No	Questions/ Items	Number (N)	Percentage (%)
1.	When can you be accused of plagiarism?		
1.	Assignment	14	6.4
	Dissertation	28	12.7
	Exam	6	2.7
	Publication	170	77.3
	Project	2	1.8
2.	Who would you ask for help about plagiarism or referencing?		
2.	Faculty	148	66.3
	English Language Centre	8	3.6
	Friend	16	7.3
	Advice Service	38	17.3
	Lawyer	10	4.5
3.	What do you think the consequences for a first offence of plagiarism could be?		
	Expulsion	18	8.2

	Warning	82	37.3
	Retake	44	20
	Monetary compensation	8	3.6
	Legal action/punishment	68	30.1
4.	How much percentage of plagiarism is acceptable?		
	10%	124	56.4
	20%	68	30.1
	30%	26	11.8
	50%	2	0.9

**Table 3: Questionnaire tool with multiple responses**

## Discussion

The present study assessed the level of awareness and reason for plagiarism regarding plagiarism among post graduate students and faculty of pediatric dentistry throughout India. Plagiarism is also referred as Fraud. Passing off of another's work as one's own or Duplicating one's own previous work without reference to prior publication.

In the present study, 78.2% of participants were not confident about referencing their own work, which shows us that teaching about plagiarism is important for ethical scientific writing. 49.1% were aware of UGC guidelines, as all post graduates and faculty does scientific writing, hence they should all be well aware of the guidelines that needs to be followed. Faculty or educators should take an initiative to introduce about UGC guidelines to post graduates students. 23.6 % of the participants weren't sure about Self-plagiarism is punishable as plagiarism. The results of a research conducted by Ford PJ, Hughes C in 2012<sup>9</sup> were in accordance with the result of present study. They state that the majority of participants reported that the guidelines for dealing with plagiarism were inadequate.

Awareness about self-plagiarism is equally important as plagiarism. As, Self-plagiarism is re-using your own findings in your several different research except few circumstances, such as review articles, anthologies, collections, or translations into another language. Citation of an individual can be used, but similar findings are not acceptable. Due to contempt of journal caused to self-plagiarism, they have an authority to uphold the further publications of the author.

52.75% and 35% participants strongly agree and agree that they require more information and knowledge regarding plagiarism and publication ethics. 66.3% Participants also believe that the knowledge or difficulty that they come across during plagiarism can be helped by faculty. The similar findings were demonstrated by a researcher where it was stated that students benefited significantly from their instruction.<sup>10</sup> Hence, Researcher must be well aware about plagiarism, ethics and copyright infringement. Scientific writing must have clear expression, conciseness, accuracy, and honesty, then only we can state it as good scientific writing. Few authors suggest that positive influence towards plagiarism in higher education contexts.<sup>11, 12</sup>

48.2% used words or sentences from articles or books while writing essays without using quotation marks, they are not well aware about the consequence which will further take place. The results of the survey done regarding the challenge for dental schools states that there is need to identify effective strategies to prevent cheating opportunities and to enforce effective knowledge for the same.<sup>13</sup> Citing, acknowledging or quoting someone's work as required by law is not appropriate, if someone uses words, phrases, phrases or ideas, or paraphrases the work of another person, it is important to name the source of information in your work. An ethical author, always acknowledges other people's contributions to his / her work. Any wording taken from another source must be contained in quotation marks and accompanied by a quotation indicating its origin. As we summarize the work of others we use our own terms in a condensed version of the original to condense and express efforts of others.

As researcher it's our moral duty to understand the penalties caused due to plagiarism, there are various Acts created by government for plagiarism and copyright infringement as discussed earlier in the present paper. In this study, 37.3% participants believed that warning was the punishment for plagiarizing.

As, the results of this study states, lot of participants weren't aware about the plagiarism checker which are usually easily available by institutes. Hence, for readers to understand we have further discussed about various tools available on web they are: Dupli Checker, Copyleaks, PaperRaterPlagiarisma, Plagiarism Checker, Plagium PlagScan, PlagTracker, Quetext and Viper. Some of these softwares are paid or at free of cost.

This research paper has evaluated post graduates and faculty on the basis of their knowledge, attitude and their daily practices of plagiarism. This paper suggests how to create more awareness about plagiarism by faculty in post graduates. Also few lectures can be

conducted to make them aware about it. They should also acknowledge post graduates about copyright infringement and self-plagiarism.

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# Block Chain Authentication Using Elliptic Curve Digital Signature Algorithm

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## Abstract

The block chain technology is the latest updated technique, where the data is being stored in a decentralized environment. The authentication deals with verifying who they are, what is their identity. The authentication is provided in the block chain by various techniques. One better way of providing authentication rather than using a two factor authentication where a single user name & password is available, it can be with the help of Digital Signature Algorithm(DSA), as in the case of DSA, deals with digital signature based on algebraic properties. It deals with two mutually authentication keys. The algorithm used for signing and verification of the message. The commonly used public key based algorithms are RSA and DSA. Here we use DSA which is an asymmetric algorithm, which generates a pair of keys, one public and one private. The DSA can be enhanced by using elliptic curve which serve as a better option for authentication techniques. The review paper explains the use of DSA with ECC (Elliptic Curve Cryptography) as a better option for authentication rather than using a two factor authentication for block chain technology.

## Keywords

Digital Signature Standard, Elliptic Curve Cryptography

## Introduction

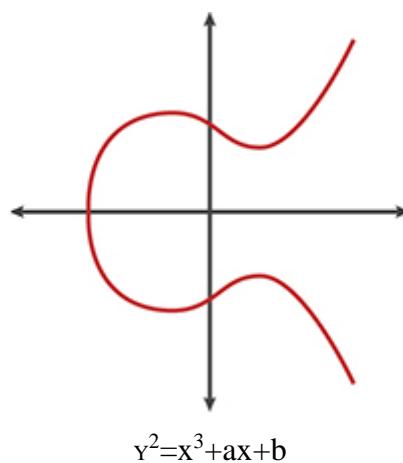
Cryptography is a technique which is used to protect data from unauthorized access. There are mechanism for secure communication that is symmetric cryptography and

asymmetric cryptography. In symmetric where same key is used for encryption and decryption. Here it deals with asymmetric key where different keys are used for encryption and decryption. One of the asymmetric techniques is Elliptic Curve Cryptography. Block chain is a type of diary or a spreadsheet containing information about transaction. Each transaction generates hash. When a transaction is approved by different nodes, then it is written in block. Each block refers to previous block and together make a block chain. Block chain is not controlled by any entity. Records are stored in any blocks. A technology to create and maintain a secure shared and distributed ledger for transaction<sup>1</sup>. The elliptic curve Digital Signature Algorithm is applied to enhance security of the ledger, which helps in the integrity of the data or the transaction. ECCDSA that is Elliptic Curve Digital Signature Algorithm is a cryptographic algorithm used by bitcoin. Bitcoin is a cryptocurrency, which uses secure algorithm for transaction<sup>2</sup>. Public key, private key and signature are used in ECCDSA.

## **Experimental methods**

### ***Elliptic Curve Cryptography***

ECC (Elliptic Curve Cryptography), is more useful in the current scenario where more people are dealing with smartphones. It offers stronger security. It uses small key size while providing a higher security<sup>3</sup>. In the latest minimum size of ECC is 256-383 and key ratio 1:12, the security bits are 128, and it is valid till the years to come. An elliptic curve is a plane curve over finite field consisting of points with equation.



**Figure 1: Elliptic curve**

### ***Elliptic Curve Digital Signature Algorithm***

As with ECC the bit size of public key needed for ECCDSA is twice the size of the security level. For example, security level of 80 bits, the size of as ECCDSA will be 160 bits.

Here we use signature generation algorithm and signature verification algorithm<sup>4</sup>. Digital Signature Algorithm is used with Elliptic Curve Cryptography to enhance the security. The algorithm works like this it takes a large prime number say p. It takes the value of a and b. Then uses a generator point. It is used to produce other points in the curve. It is working in finite field. We will use the private keys for signing<sup>5</sup>.

- Pick a random number k, a temporary private key
  - Produce a temporary public key ( $P_k = k * G$ )
    - $R = X_{P_k}$
  - $S = k^{-1} (\text{Hash}(m) + \text{prvKey} * R) \bmod p$

**Figure 2: Signing Algorithm**

- Calculate a Point of the EC: the temporary Public key  

$$P = S^{-1} * \text{Hash}(m) * G + S^{-1} * R * \text{PubKey}$$

**Figure 3: Verifying Algorithm**

## Two factor authentication

Two factor authentication techniques are better than single factor authentication; in which user provide one authentication that is password. In this mechanism they give password, as well as other credentials such as face or, fingerprint recognition.

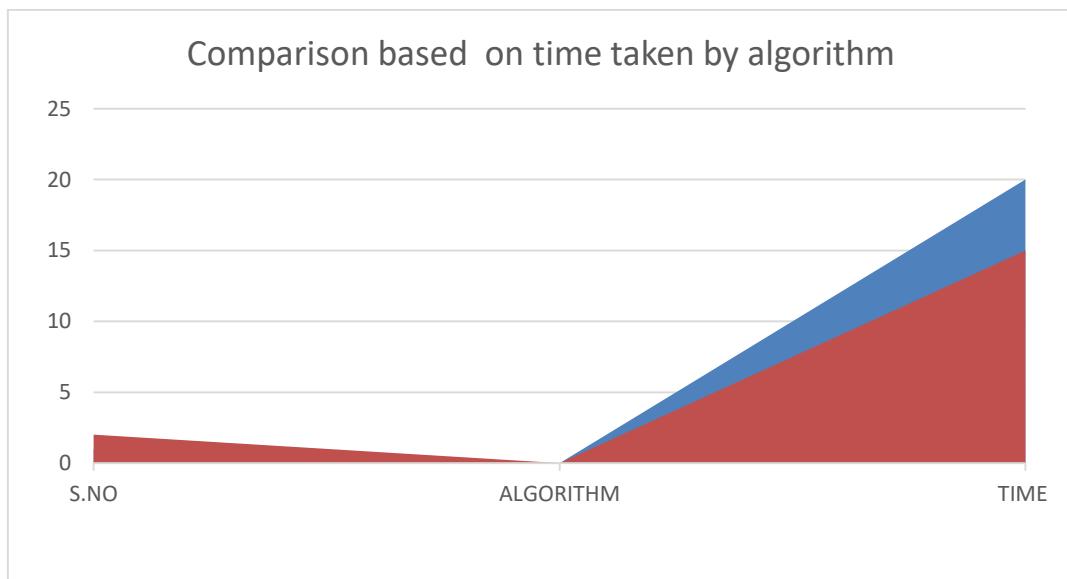
## Multifactor authentication

Here only access is provided after presenting two or more authentication factor. It enhances security as granting access is permitted with more credentials. More credentials in the sense if it is an organization then user will login. This is also controlled by the admin, who login with his or her credentials.

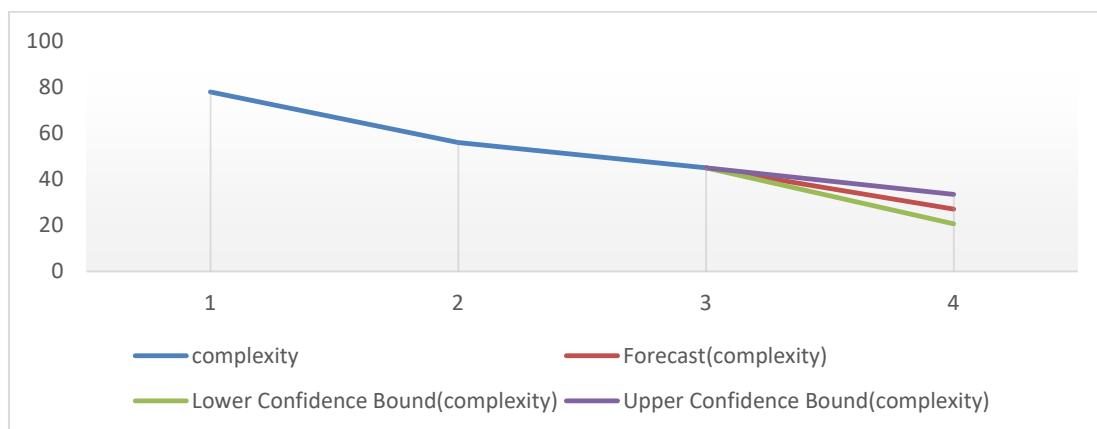
## Results and Discussion

### *Analysis of ECC and ECCDSA*

This figure explains the difference between ECC and ECCDSA. Elliptic Curve Cryptography, which is a secure technique for communication. In which data are stored in x and y coordinates as it is difficult to break. Digital Signature Standard mechanism provides integrity of the message. The comparison table explains about time taken by Rivest Shamir Adleman with Elliptic Curve Cryptography.



**Figure 4: Comparison of ECC and ECCDSA**



**Figure 5: Time Complexity Comparison of DSA and ECCDSA**

The table below explains the algorithm, key length and symmetric key length of various cryptographic techniques. It explains the performance of other authentication techniques with the proposed technique with lesser key size.

Sr. No.	Algorithm	key length	Symmetric key length
1	Rivest Shamir Adleman	1024	80
2	ECC	163	80
3	ECCDSA	160	80

**Table 1: Algorithm and key sizes**

## Conclusion

Digital Signature Algorithm is used for providing integrity to a message by using signing and verification algorithm. The block chain technology is used for transaction in a distributed environment. The two factor authentication techniques offer less authentication approach than ECC. The ECC provide more security using less key size for block chain. In this approach integrity is also met with the help of DSA. The block chain technology can be further enhanced for IoT devices. For enhancing security in IoT ECCDSA can be applied.

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