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MESSAGE
From the Chief Editor

"Education is the kindling of a flame, not the filling of a vessel." - Socrates

In this kinetic landscape of education, where knowledge is both the bedrock and the catalyst for transformation; self-reflexive thought and reasoning serve as beacons which illuminate the path towards innovative pedagogies,novel practices, and creative research. It is this transformative flame of vitality, which Socrates speaks of, that keeps the fundamental essence of education enduring - to engage in a deliberate, incisive, and reflective process to gain the power to discern, evaluate, and construct well- informed opinions on the shifts in the field of education.

I am pleased to present this year's edition of 'MAGIS - Xaverian Journal of Education', the annual journal published by the Postgraduate Department of Education of St. Xavier's College (Autonomous), Kolkata. This publication is a testament to the hard work and dedication of our students and faculty who have contributed their research and academic work to this journal. MAGIS offers a platform for students and educators to critically explore and showcase their visionary thinking, approaches and interdisciplinary ideas in their collective pursuit of knowledge and excellence in education.

I commend Dr. Swati Sarkar, Vice-Principal of the Postgraduate Department of Education, along with the dedicated faculty and students whose diligent commitment, enthusiasm and energy have given life to this year's MAGIS. I extend my heartfelt gratitude to the various contributors, reviewers, and the entire editorial team for their unwavering devotion to scholarly excellence. Your commitment to academic curiosity and scholastic rigour is truly commendable.

I eagerly look forward to the impact that this edition of 'MAGIS - Xaverian Journal of Education' will undoubtedly have on our educational community.

Nihil Ultra (Nothing Beyond)

God bless our efforts

Rev. Dr. Dominic Savio, S.J.
Principal

The Vice-Principal
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EDITORIAL

Dear Contributors and Readers,

I extend a warm and hearty welcome to you in the pages of *MAGIS*, the esteemed Double Blind Peer Reviewed Interdisciplinary annual Journal of Postgraduate department of Education, St. Xavier's College (Autonomous), Kolkata.

MAGIS, meaning "more" or "greater" in Latin, reflects our relentless commitment to fostering academic excellence in the field of education. This journal serves as a platform for the dissemination of knowledge, showcasing research papers contributed by various talented, erudite scholars and practitioners. We believe in the transformative power of education, and *MAGIS* strives to be a catalyst for intellectual growth and the advancement of educational practices. This sentiment is emphasized by Martin Luther King's assertion, "The true goal of education is to cultivate both intensive and critical thinking, combining intelligence with character."

As the Managing Editor, I am proud to witness the cultivated scholarly endeavours illustrated within these pages. The myriad range of research papers presented in *MAGIS* reflects the depth and breadth of our collective dedication to understanding, perceiving and enhancing the field of education.

I invite you, dear readers, to dive deep into the wealth of knowledge within these pages of *MAGIS*, and I encourage scholars and educators alike to continue contributing to the ongoing wide discourse on education. Your research and insights play a crucial role in shaping the future of education, aligning with the Jesuit values upheld by St. Xavier's College (Autonomous), Kolkata. As Malcom X rightly put it, "Education serves as our passport to the future, as tomorrow is reserved for those who diligently prepare for it today."

Thank you for your commitment to excellence and diligence, and I look forward to the continued success and growth of *MAGIS* as a beacon of intellectual enlightenment and scholarly exploration.

It is with the constant support, inspiration and encouragement of our beloved Father Principal, Rev. Dr. Dominic Savio, S.J., that this publication has been made possible.

I would like to extend my thanks and heartfelt gratitude for the enthusiasm, effort and co-operation of the editorial board.

Swati Sarkar

Dr. Swati Sarkar
Managing Editor, MAGIS
Vice-Principal

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From Policy to Practice: Current Status & Issues of Inclusive-Classroom settings in Government - Aided Schools of West Bengal

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Abstract

Since 1854 to 2023, various commissions have been set up regarding the education system, many schemes have been devised as well, all of whom emphasize on the concept of Inclusive Education. Our country has moved one step forward to implement the inclusive classroom. The obstacles which prevent the children with special needs to enter into the mainstream classroom, the commission and schemes are ready to break those obstacles. So basically the remedies are ready but question is arises with the implementation of these practices. This research aims to identify the obstacles posed in the way of execution of inclusion as faced by the teachers and students in secondary section. It would also deal with the attainment of teachers as primary executors of this system in the aforementioned section and their experiences during the procedure. So the researcher has done a Mixed-method research with 25 students and 25 teachers which was collected from 25 Government-aided School of West Bengal. And the data was collected through checklist and Semi Structured Interview. After analysed the data it is cleared that most of the inclusive practices which is necessary to run an inclusive classroom is not available.

Key word: *Children with special needs, Classroom settings, Inclusive practices, Institutions of West-Bengal, Policy Implementation*

Introduction:

Only legislation can eventually bring about meaningful change in a uniform manner in a country like India, where the number of specially abled is so large, their issues are complicated, available resources are rare, and social attitudes are destructive. A paradigm change towards inclusion is taking over global educational debates. All children, irrespective of their special needs or language learning disabilities are entitled to study in an United Nations Declaration. Inclusive education means to educate all pupils, even if they have learning disabilities alongside the normal students to give them an equal opportunity to lead their lives. It wishes to put emphasis on specific children who are

endangered to be marginalised and excluded under normal circumstances. Historically, individuals with physical disabilities faced exclusion and rejection from their communities as well as from the educational Institutions. However, some evidence now strongly advocates for the idea of inclusion, emphasizing the importance of supporting all learners to ensure that they can fully engage in the learning experience(Chitereka, 2010; Kearney, 2009).It implores the possibility of making all learners to be able to learn together, with or without disabilities, across pre-schools, schools and other educational institutions provided with a proper network of support. This can happen only if the system of education becomes flexible and takes into consideration the needs of learners and moulds itself to meet the needs of all.

Teachers are crucial in ensuring the quality of education, as they play an essential role in shaping the educational experience. The effectiveness of an education system is inherently tied to the proficiency and dedication of its teachers (Savolainen,2009). Research indicates that teacher quality has a more significant impact on learner achievement than any other factor, surpassing considerations such as class size, class composition, or background (Naong, & Mateusi,2014).

India revised its policy to encourage the education of child with disabilities and other special needs in the wake of the Salamanca Statement (UNESCO, 1994). Students with and without impairments both stand to benefit greatly from inclusion programs if they are put into effect (Right to Education Act 2009; Singh, 2016). Unfortunately, Tiwari et al. (2015) found that the implementation of inclusion in Indian schools was inconsistent at best. The idea is supported by the United Nations' Standard Rules on Equalization of Opportunities for Person with Disability Proclaiming Participation and Equality for All. Presently, the Indian horizon of pedagogues have joined hands to help inclusive education get adopted in the Indian mainstream schools.

Till 1990, out of the 40 million Indian children, who were within the age group of 4 to 16 years and had physical or mental disabilities where always excluded from attaining mainstream education. The Constitution of India ensures Social Justice and Equity, which demands the 35 million physically challenged children to attain proper education. But the reality is different, since only one tenth of such students are enrolled, the rest are denied such opportunity. Since 1854 to 2023, various commissions have been set up regarding the education system, many schemes have been devised as well, all of whom emphasize on the concept of Inclusive Education.

The NEP (2020) recognizes the importance of inclusive education and emphasizes the need to create an education system that is inclusive and equitable. The policy outlines several measures to achieve this goal, including the establishment of special education zones and the promotion of multilingualism and cultural diversity. After 34 years, the National Education Policy has been released based on the recommendations made by the Kasturirangan Committee (2019). There were four sections to the policy. Under school education, equitable and inclusive education is covered (NEP,2020).The RPwD act of 2016 is consistent with NEP 2020. The statute also placed a focus on discrimination-free access by eliminating physical obstacles (Narayan& John 2017).

To achieve this equitability goal, the policy recommends several measures to ensure that

students from all backgrounds and abilities can access quality education. One of the key recommendations of the NEP 2020 for inclusive education is the establishment of special education zones. These zones will provide specialized support and resources for students with disabilities and other learning needs. The policy also recommends the development of appropriate infrastructure and resources to support students with disabilities, including accessible classrooms, assistive technology, and trained teachers. This study addresses the research question by investigating what obstacles are posed in the way of the execution of inclusion, as faced by teachers and specially abled students in the secondary level schools and how obstacles are made the problems in implementation of inclusive classroom.

Objectives:

1. To explore the effective practices for children with special needs in secondary schools of West-Bengal.
2. To study the challenges faced by the teachers and students for teaching-learning process in the inclusive setting.
3. To investigate the issues faced by the 'specially abled students' in inclusive classroom.

Research design:

The study has conducted by following Mixed-method approach (QUAL-quan). Triangulation of data has been done from different samples. All the Government-aided secondary schools of West Bengal are taken as population.

- *Sampling:*

To collect the data stratified random sampling technique was used. There are Five administrative divisions are present in West Bengal. From each division 5 secondary schools (WBBSE) were selected randomly and from each school one teacher and one student are selected to collect data. Finally, 25 teachers and 25 students were considered for the study.

Table 1: Distribution of Samples

Administrative Division	**No. of Secondary Institutions**		**Samples (01 teacher from each school)**	**Samples (01 students from each school)**
	Rural	Urban		
Presidency	01	04	05	05
Medinipur	02	03	05	05
Burdwan	03	02	05	05
Malda	03	02	05	05
Jalpuiguri	02	03	05	05
Total no.	**25**		**25**	**25**

Instrumentations:

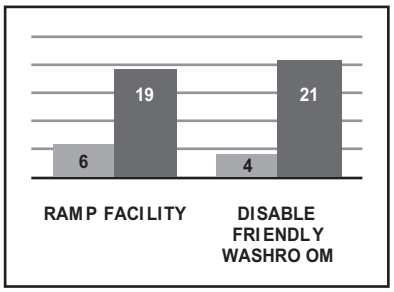
To collect data for the study following tools was used:

1. Semi-Structured Interview
2. Checklist for infrastructure and material resources

The content validity had checked for the interview schedule by experts. Percentage and several graphical representations had been used by the researcher to analyze and describe the collected data.

Analysis of the Study:

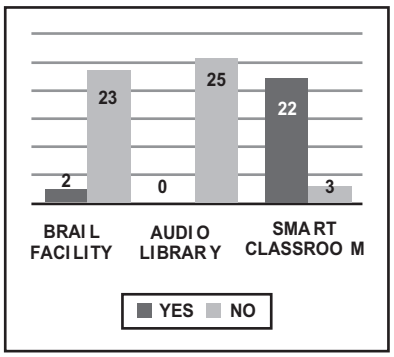
- *Infrastructure:*



RAMP facility is the mandatory part for any institution where physically challenged learner are there. About 24% teachers mentioned that their institutions having such kind of facility. And finally, the washrooms should be disabled friendly. 84% teachers stated that the washrooms are not developed for inclusive school. This is a serious challenge for implementation of inclusive practices for the children with special needs. Only one co-educational secondary school have one washroom which can be used for 'all' and three schools have washroom for specially abled students. And eventually the four schools are from urban area. The ramps are also available in urban schools and the ramps are only for entrance.

- *Resources and Teaching method:*

A sign language is a language which chiefly uses manual communication to convey meaning, as opposed to acoustically conveyed sound patters (Hayes,2017). This can involve simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to express a speaker's thoughts. All students confirmed that the teacher doesn't use this process for better understanding for the content delivery. But teachers said that they usually change their gestures and posture in the classroom and sometimes by hand movement and expressions teachers want to make them understandable, teachers are not got any training for sign language. Brail facility is important tools for studying of visually impaired children and audio library is essential for HI students. But 8% respondent clearly mentioned that they have accommodate brail facility for the children with visually impaired but which is not used and all respondents stated that audio library facility is not available. Slow learners can't learn in the normal classroom. For those student remedial classes are important. Use of innovative teaching learning material greatly influenced the learning process. It is most useful for the slow learner. Students are claiming that Teaching learning material are rarely used in classroom (Mostly for science and sometimes for geography). Use of technology can promote physical and psychological



rehabilitation of children with disabilities by reducing effect of disabilities and enhancing their potentials. 88% teachers said that the schools have projectors, smart boards, computers but again the urban schools are using those devices to visualize the content.

- *Curriculum:*

For inclusion to happen, it is important to adapt the general education curriculum to meet the special educational needs of some students to allow for their full participation. No student should be excluded from activity due to the fact that he/she cannot perform all the skills. Here out of 25 teachers only 3 people said, 'We don't focus in completing the whole syllabus for special need students. We just cover the basic and essential part of the syllabus'. And rest of the schools are imposed the complete syllabus for all students. 88% respondents confirmed that schools are offering adequate sports facility for children with special needs. Here remarkably one school brought 'National Championship for Kabadi' for their school and teacher reported that the slow learner and some ST students had actively participated on Kabadi. Beside this participation in cultural programmed helps to acquire different skills and gaining innovative thinking for all the students but 96% stated that the students with special needs are getting chance to take part in cultural programmed and they enjoyed.

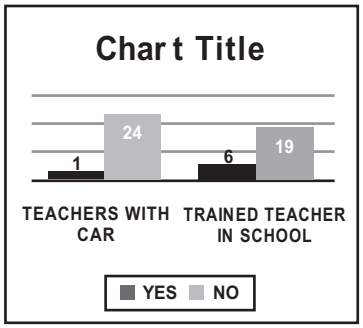
One teacher said, 'Though they (slow learner) are very much obedient, they honestly try to participate in events (Saraswati puja, Annual cultural programme) and also they efficiently finish the work which is really appreciable.'

- *Teachers for inclusive classroom:*

For teaching of special needs children in the field of Rehabilitation and Special Education all the teacher must have CRR (Central Rehabilitation Registration) number. But at the present scenario teachers do not have any such kind of number, so they are not eligible for teaching to special needs children. Among the 25 respondents only 10% of them said that their institution avail well trained teacher. Even there is no Special Educator in any school. For lack of this, normal teachers are taking the class with normal children.

One teacher said, *'There is no special educator in the school, and as a result, there is a lack of knowledge on how to create Braille. Additionally, there is no knowledge with sign language. Basically, I have a lack of understanding on how to effectively engage with students with disabilities.*'

According to the teachers it is not so easy to handle a big class-room; when the teachers student ratio is not maintained, then it is not possible to pay attention to an individual student. Teachers are reported that the no of students of one class is excessive. Sometimes it became 150-360.



One teacher said, 'In my class, there are a total of 332 students. Not everyone attends every day, so managing the class is possible. If

everyone will come to school to attend daily, there wouldn't be enough seating. And that time to consider everyone's opinions is also difficult, and managing the class becomes even more challenging. So, creating an inclusive classroom setup with so many students is indeed tough.'

Every teacher complaining, when there is an especially abled student in a classroom then it seems impossible to pay special attention to that child because other students in that particular class, loose focus from not only the subject, but also from the teacher when the teacher tries to pay an extra attention to that especially abled student. In this way, neither the general students nor the especially abled students can learn properly and both of them face a lot of problems their problems remain unsolved and creating problems for the implementation of inclusive education for learners with learning disabilities in secondary schools in West-Bengal.

Sometimes the 'specially-abled children' are bullied in the classroom and they became depressed and demotivated. For this the school should have guidance and counselling programmed for the students. 88% of the respondent said that there is no such programmed are arranged for the children with special needs. Cause for this is most probably the children who are come to learn maximum of them are first generation learner is from rural area and the parental family income is low enough.

Discussion and Conclusions:

Naidoo et al. (2014) documented the necessary prerequisites for a successful implementation of inclusive education. Among these, they highlight the provision of various forms of support, such as: allowing a flexible curriculum for some child, the availability of well trained and prepared special needs education teachers, and the modification of school community cultures to go beyond tolerance to acceptance.

Although effective implementation of inclusive education is repeatedly written in the papers, in reality, the government aided secondary and higher secondary institutions portray a quite different picture. In a country like India (that has a population of 1.4 billion), it is not easy to completely and equally implement any policy. Hence, the same goes for inclusive education. An important potential risk involves the hiring of less experienced and less effective teachers for inclusive classrooms (Szumski, et.al,2017). And from the study it has been found that to continue with the implementation of inclusive settings in the classroom of school would require vigorous orientation programmes, seminars, awareness programmes and workshops for the teachers. In the realm of education, the learning doesn't play just for students; teachers are learners too! Embracing the tune of an inclusive classroom requires a continuous rhythm of upgrades. Professional training for teachers empower them to identify children's specific needs, implement preventive teaching strategies, and collaborate with specialists to effectively administer remedial and corrective instruction (Davis et al.,2004).

Teachers, must harmonize with the ever-evolving notes and strategies of inclusivity in the classroom to lead their students learning effectively. Other than that, necessary resources required to

make an inclusive classroom should be prepared. The overwhelming number of students poses a significant obstacle in creating an inclusive setting and practices within the classroom. Ensuring an optimal student-teacher ratio in the classroom is not just a recommendation; it's the secret for personalized learning. By maintaining this ratio, teachers can unlock the door to providing individual attention, nurturing unique talents, and fostering a dynamic and engaging learning environment for each student and also can understand the special needs of the students by case study. If the financial support in all the aspects are obtained from the central and the state government, it would be of utmost help. Otherwise, the teachers would also need to provide financial support at a personal level. Students should also get access to proper counselling, guidance and mentoring sessions. To have access to various facilities and connectivity, the schools in the urban areas are better equipped than the ones in villages. From the statement of the teachers, it is understood that the headmaster of the school has enough role to as a leader as he takes most of the decisions related to the institution and always directs the school towards a progressive path. In the schools, the absence of special educators is akin to navigatinga big issue. Sometimes, teachers, the captains of classrooms, are also helpless to find the effective way to teach everyone in the classroom at the same time. And in this crucial time they need the consultation from special educators. Teachers claimed the expertise of specialized educators as the 'transformative power'and charting a course for inclusive education that benefits every student. The dynamic duo of team teaching and collaborative approaches holds the key to unlocking an inclusive setting within the classroom, which bring the changes in academic achievement of all students (Welch, 2000). Academic achievement is not always the ultimate measure of success. According to teachers, every individual, especially those with special abilities, has their own place of brilliance. To channelize and nurture these special talents, there is a pressing need for specialized teachers who can understand and guide students with diverse abilities towards their unique strengths and potentials. By joining forces, educators create a powerful synergy, fostering an environment where every student feels supported, valued, and ready to embark on a journey of shared learning and growth and also success extends beyond traditional academic metrics, embracing the richness of individual talents and capabilities.

Standing at the end, we have to remember that for implementation of any policy, each stakeholder should be directly involved. Thus, both the teachers and the students have to support and understand the concept of building an inclusive institution. NEP 2020 also recognizes the need to address the learning needs of students with disabilities and provides for the development of appropriate infrastructure, resources, and teaching methods to support them. Lack of optimum resources and the response of the various schools have not been on a high positive note (Efendi,2018). The special needs of children's education in inclusive schools have not received appropriate educational services based on their needs. At last it has been seems that there is a formal acknowledgment and integration of inclusive education policies in the government-aided school system, the translation of these policies into effective practices remains a work in progress.To truly

achieve inclusive education, a concerted effort is required from educational authorities, schools, and communities, ensuring that the principles of inclusivity are not only enshrined in policy but also deeply embedded in the everyday practices of West Bengal's government-aided schools.

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Enhancing Digital Literacy Competencies through Adaptive Learning Strategies in Blended Teaching Environments

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Abstract

The National Education Policy (NEP) in India underscores the critical role of digital literacy in the contemporary education landscape. With the rapid integration of technology in education, the NEP emphasizes the need to equip students with digital skills to thrive in a technology-driven world. Digital literacy, as portrayed in the NEP, encompasses not only basic computer skills but also the ability to critically evaluate information, navigate online platforms, and engage responsibly in the digital space. Furthermore, the NEP promotes a blended mode of teaching, recognizing the transformative potential of combining traditional classroom methods with digital learning tools. The shift towards blended learning aims to create a dynamic and inclusive educational environment. Blended learning in the NEP involves the judicious integration of online and offline resources, providing students with flexibility, personalized learning experiences, and exposure to diverse educational content. This abstract highlight the NEP's commitment to nurturing digital literacy as a foundational skill and acknowledges the potential of blended learning to enhance the quality and accessibility of education in India. The policy envisions a holistic approach that not only prepares students for the digital age but also fosters innovation and adaptability in the education system. Stakeholders, including educators and policymakers, are encouraged to collaboratively implement and continually refine strategies to ensure the effective integration of digital literacy and blended learning in the Indian education system.

Keywords : *Adaptive Learning, Blended Learning, Digital Literacy*

1. Introduction

In the rapidly evolving landscape of education, the integration of digital literacy has become imperative, reshaping traditional teaching paradigms. The emergence of blended learning, combining face-to-face instruction with online components, presents a promising avenue for fostering digital literacy competencies among students and educators alike (Saud, 2021). This research endeavours to explore the theme of "Enhancing Digital Literacy Competencies through Adaptive Learning Strategies in Blended Teaching Environments," aiming to investigate the dynamic intersection between digital literacy and adaptive instructional approaches within blended learning frameworks.

1.1. Background : Digital literacy, encompassing the ability to critically engage with and leverage digital technologies, is an essential skill set in the 21st century. As educational institutions strive to prepare students for a technologically driven world, blended learning has gained prominence as an effective pedagogical model (Saud, 2021). Blended learning environments seamlessly integrate traditional classroom interactions with online resources, offering a diversified and flexible approach to education.

1.2. Rationale : While the benefits of blended learning are increasingly recognized, understanding how adaptive learning strategies within this model can specifically enhance digital literacy competencies is a nuanced inquiry. Adaptive learning involves the use of technology to tailor educational experiences to the individual needs and progress of learners.[2] By personalizing content delivery, adaptive strategies have the potential to optimize the acquisition of digital literacy skills, catering to diverse learning styles and abilities (Saud, 2021).

1.3. Research Objectives : This research aims to achieve the following objectives:

1. To evaluate the current state of digital literacy competencies among students and educators in blended learning environments.
2. To investigate the effectiveness of different blended learning models in fostering digital literacy skills.
3. To explore the role of adaptive learning platforms in personalizing instruction for enhanced digital literacy acquisition.
4. To examine the impact of professional development programs on educators' ability to integrate adaptive strategies for digital literacy enhancement.
5. To assess the relationship between digital literacy integration, student engagement, and overall learning experiences in blended environments.

1.4. Significance : The findings of this research hold significant implications for educators, policymakers, and institutions committed to optimizing the integration of digital literacy in blended learning settings. Understanding how adaptive strategies can be leveraged to enhance digital literacy competencies has the potential to inform instructional practices, curriculum development, and policy decisions, ultimately contributing to the preparation of students for a digitally-driven future (Saud, 2021).

In summary, this research seeks to shed light on the intricate dynamics of fostering digital literacy in blended learning environments through adaptive strategies. By delving into the nuances of this intersection, the study endeavors to provide actionable insights that can guide the evolution of instructional practices and policies in the ever-changing landscape of education.

2. Methodology

2.1. Literature Search : The study conducted a comprehensive literature search using academic databases (e.g., PubMed, IEEE Xplore, ERIC, JSTOR) and search engines. Keywords included "digital

literacy," "adaptive learning," "blended learning," and related terms. The study identified relevant peer-reviewed articles, books, conference papers, and reports published in the last decade.

2.2. Inclusion and Exclusion Criteria : The study established clear criteria for inclusion and exclusion of literature. It included the studies that specifically focussed on digital literacy, adaptive learning strategies, and blended teaching environments. The research excluded the studies that do not directly address these themes or are not published in English.

2.3. Thematic Analysis : The study performed a thematic analysis to identify recurring themes, patterns, and key concepts across the selected literature. It categorized findings into themes such as the effectiveness of adaptive learning platforms, impact on teacher professional development, and outcomes on digital literacy competencies.

2.4. Synthesis of Findings : The study synthesized the findings to create a cohesive narrative that outlines the current state of knowledge on enhancing digital literacy competencies through adaptive learning in blended teaching environments. It identified gaps, inconsistencies, and emerging trends in the literature (Bansal, 2014).

2.5. Comparative Analysis : The study conducted a comparative analysis of studies, comparing methodologies, participant demographics, and outcomes. It explored variations in adaptive learning strategies, digital literacy measurement tools, and the contextual factors influencing the effectiveness of these strategies.

3. Results

3.1. Current state of digital literacy competencies among students and educators in blended learning environments

India, including West Bengal, has been making efforts to enhance digital literacy through various initiatives. Programs like Digital India aim to empower citizens through digital literacy training. Access to digital devices and the internet plays a crucial role. While urban areas may have relatively better access, rural areas, including parts of West Bengal, might face challenges. The government of India, in collaboration with state governments, has been implementing schemes to provide digital education tools. However, the effectiveness of these initiatives can vary. Schools and higher education institutions have been incorporating digital tools into teaching (Nithish, 2023). However, the extent to which educators and students are proficient in utilizing these tools can differ. Skill development programs, both governmental and private, have been offering digital literacy courses. However, Limited access to reliable internet and a lack of proper infrastructure can impede the effective implementation of digital learning. Socio-economic factors can influence digital literacy. Students from economically disadvantaged backgrounds might face challenges in acquiring and maintaining digital devices. Thus, educators' proficiency in using digital tools for teaching is crucial. Adequate training and professional development opportunities may be necessary (Kumar, 2022). Besides,

Language can be a barrier to digital literacy. While English proficiency is often crucial for utilizing online resources, there's a need for content in regional languages.

3.2. Different blended learning models in fostering digital literacy skills

Blended learning combines traditional face-to-face instruction with online components, offering a flexible and personalized learning experience. Various models of blended learning have emerged, each with its unique approach to fostering digital literacy skills. These are flipped classroom model, station rotation model, flex model, online lab model, hybrid-flexible model, enriched virtual model, and project-based blended model. In the flipped classroom model, students engage with digital content, such as video lectures or online modules, before attending in-person classes (Sapkota, 2020). Class time is then used for discussions, collaborative activities, and hands-on application of digital skills. Students develop digital literacy by accessing and critically evaluating online resources, engaging with multimedia content, and participating in online discussions. In the station rotation model, students rotate between different learning stations, including a station for online activities. Digital literacy skills are developed as students interact with online content, applications, or simulations at the designated station. Students build skills in navigating online platforms, utilizing educational software, and critically evaluating digital information. The flex model provides students with a degree of control over the pace, path, and time of their learning. Digital resources and activities are available for students to access independently, allowing for personalized learning experiences. Students develop self-directed learning skills, digital research skills, and the ability to manage their online learning resources effectively (Muralidharan et al., 2022).The online lab model involves students working on digital assignments, projects, or simulations in a virtual lab setting. This can be complemented with periodic face-to-face sessions for discussions and collaborative activities. Students acquire hands-on experience with digital tools, practice problem-solving in a virtual environment, and enhance their collaborative digital skills. The HyFlex model allows students to choose between attending in-person classes or accessing the same content online. This model accommodates different learning preferences and situations, offering a blend of face-to-face and online experiences (Mulajkar and Pinamkar, 2021).Students develop the ability to navigate various online platforms, engage in both synchronous and asynchronous digital communication, and manage their learning preferences effectively. In the enriched virtual model, the majority of learning takes place online, with periodic face-to-face sessions for activities that benefit from in-person interaction. This model provides flexibility while maintaining a strong online presence. Students practice effective online communication, collaboration, and time management skills while engaging with a variety of digital resources. Project-based blended model incorporates project-based learning, where students collaborate on projects that integrate digital tools and technologies. Face-to-face sessions may be used for project planning, presentations, and discussions (Mulajkar and Pinamkar, 2021). Students develop skills in project management, digital collaboration, and the effective use of technology to solve real-world problems.

3.3. Adaptive learning platforms in personalizing instruction for enhanced digital literacy acquisition

Adaptive learning platforms play a crucial role in personalizing instruction, tailoring educational experiences to individual learner needs. When applied to digital literacy acquisition, these platforms can provide targeted and adaptive content, assessments, and feedback to enhance the effectiveness of learning. There are some ways in which adaptive learning platforms contribute to personalized instruction for enhanced digital literacy acquisition (Dey and Bandyopadhyay, 2019).

1. Individualized Learning Paths:

Adaptive platforms analyze learners' strengths and weaknesses, creating customized learning paths. This personalization ensures that students focus on areas where they need improvement, allowing for a more efficient acquisition of digital literacy skills (Laskar et al., 2023).

2. Real-Time Feedback:

Adaptive platforms offer immediate feedback on assessments and activities, guiding learners through the learning process. This real-time feedback helps students understand their progress, identify areas of challenge, and make corrections promptly.

3. Dynamic Content Presentation:

The adaptive nature of these platforms allows for dynamic content presentation. Learners receive content in a format that matches their learning style and pace, whether through text, multimedia, interactive simulations, or other resources.

4. Adaptive Assessments:

Adaptive learning platforms employ assessments that adjust difficulty levels based on individual performance. This ensures that learners are appropriately challenged, fostering a deeper understanding of digital literacy concepts.

5. Data-Driven Insights:

Platforms collect and analyze data on learners' interactions, preferences, and performance. Educators can use these insights to make informed decisions, adapting their teaching strategies to address specific digital literacy needs within the class.

6. Scaffolding Support:

Adaptive platforms provide scaffolding support, offering additional resources or guidance when learners encounter difficulties. This feature ensures that students receive the necessary assistance to overcome challenges in their digital literacy journey.

7. Progress Tracking:

Learners and educators can track progress through dashboards and reports provided by adaptive

platforms. This transparency enables individuals to monitor their growth in digital literacy competencies and allows educators to intervene when necessary.

8. Gamification Elements:

Some adaptive platforms incorporate gamification elements, turning learning into an engaging and interactive experience. This approach can motivate learners to actively participate in digital literacy activities while tracking and rewarding their achievements.

9. Integration of Multimedia Resources:

Adaptive platforms often integrate multimedia resources such as videos, interactive modules, and simulations. This multimedia-rich environment caters to diverse learning preferences and enhances the overall digital literacy learning experience.

10. Accessibility Features:

Adaptive platforms may include accessibility features, accommodating learners with diverse needs. Features such as text-to-speech, adjustable font sizes, and language options contribute to a more inclusive digital literacy learning environment.

11. Continuous Adaptation:

These platforms continuously adapt based on learner performance, ensuring that the learning experience evolves as individuals progress in their digital literacy skills. This adaptability is key to meeting the changing needs of learners over time.

By leveraging adaptive learning platforms, educators can create a more personalized and effective learning journey for students as they acquire essential digital literacy skills. This approach acknowledges the individuality of learners and optimizes the educational experience to align with their unique needs and preferences.

3.4. Professional development programs on educators

Professional development programs play a crucial role in equipping educators with the knowledge and skills necessary to integrate adaptive strategies for digital literacy enhancement. These programs aim to empower teachers to effectively leverage technology and adaptive learning tools in their instructional practices. Here is how professional development programs contribute to educators' ability to integrate adaptive strategies for digital literacy enhancement:

1. Foundational Knowledge:

Professional development programs provide educators with foundational knowledge about digital literacy concepts, the importance of adaptive learning, and emerging trends in educational technology. This knowledge serves as the basis for incorporating adaptive strategies into teaching practices.

2. Hands-On Training:

Effective professional development includes hands-on training sessions where educators engage

with adaptive learning platforms and digital tools. Through practical experience, teachers gain confidence in navigating these technologies and incorporating them into their teaching methodologies.

3. Understanding Adaptive Learning Platforms:

Educators learn about the features and functionalities of adaptive learning platforms, including how these platforms analyze data, personalize content, and provide feedback. Understanding the capabilities of adaptive tools is crucial for informed integration into the curriculum.

4. Alignment with Curriculum Objectives:

Professional development programs guide educators in aligning adaptive strategies with curriculum objectives and learning outcomes. Teachers learn how to use adaptive tools to address specific digital literacy skills and seamlessly integrate them into existing lesson plans.

5. Differentiated Instruction Techniques:

Educators acquire skills in differentiated instruction, learning how to tailor their teaching methods to accommodate diverse learning styles and abilities. Adaptive strategies allow for individualized instruction, and professional development helps teachers leverage this to meet the needs of every student (Gandhi, 2022).

6. Data Analysis Skills:

Training programs focus on developing educators' data analysis skills. Teachers learn how to interpret data generated by adaptive learning platforms, identify patterns in student performance, and use this information to inform instructional decisions and interventions.

7. Customizing Learning Paths:

Professional development emphasizes the ability to customize learning paths for students using adaptive strategies. Educators learn how to create personalized learning experiences that cater to individual strengths, weaknesses, and preferences in the context of digital literacy (Singh, 2016).

8. Integration of Formative Assessment:

Educators are trained to integrate formative assessment techniques facilitated by adaptive platforms. This includes understanding how to use ongoing assessment data to inform real-time instructional adjustments and provide timely feedback to students.

9. Addressing Equity and Inclusion:

Professional development programs highlight strategies for addressing equity and inclusion when integrating adaptive strategies. Educators learn how to ensure that digital literacy enhancement is accessible to all students, regardless of background or learning abilities.

10. Collaborative Learning Communities:

Opportunities for collaboration and sharing best practices are integral components of professional development. Educators engage in collaborative learning communities where they can exchange ideas, experiences, and successful strategies for integrating adaptive tools.

11. Continuous Learning and Updates:

As technology evolves, professional development programs emphasize the importance of continuous learning. Educators are encouraged to stay informed about new developments in adaptive learning and digital literacy, ensuring their skills remain current.

By investing in professional development programs focused on adaptive strategies for digital literacy enhancement, educational institutions can empower educators to create dynamic, personalized learning environments that effectively prepare students for the digital age.

3.5. Relationship between digital literacy integration, student engagement, and overall learning experiences in blended environments

The relationship between digital literacy integration, student engagement, and overall learning experiences in blended learning environments is intricate and multifaceted. Here is an exploration of how these elements intersect:

1. Increased Engagement through Technology:

Digital Literacy Integration: When digital literacy is effectively integrated into the curriculum, students engage with a variety of online tools, resources, and multimedia content. This engagement is not only a means to acquire digital literacy skills but also a pathway to foster active participation in the learning process (Das et al., 2014).

Student Engagement: The incorporation of technology often aligns with students' preferences and familiarizes them with interactive and dynamic learning experiences. This can contribute to increased engagement as students explore, create, and collaborate in digital environments (Bansal, 2014).

Overall Learning Experience: A heightened level of engagement positively influences the overall learning experience. Students become active participants in their education, leading to a more immersive and meaningful learning journey (Sarma and Devi, 2021).

2. Personalized Learning Opportunities:

Digital Literacy Integration: Adaptive learning platforms and digital resources provide opportunities for personalized learning, allowing students to navigate content at their own pace and delve deeper into areas of interest. Digital literacy skills enable them to make informed choices in selecting and utilizing these resources.

Student Engagement: Personalized learning experiences cater to individual interests and learning preferences, increasing student motivation and investment in their education. The ability to explore topics that resonate with them enhances engagement.

Overall Learning Experience: Personalization contributes to a positive overall learning experience by addressing the diverse needs of students. As they take more control of their learning, students are likely to find the educational journey more relevant and fulfilling (Sarma, and Devi, 2021).

3. Collaboration and Interaction:

Digital Literacy Integration: Digital literacy involves effective communication and collaboration in online spaces. Integrating tools for collaborative projects, discussions, and peer feedback fosters digital communication skills.

Student Engagement: Collaborative and interactive activities promote social engagement. Students work together, share ideas, and contribute to group projects, creating a sense of community in the blended learning environment.

Overall Learning Experience: The ability to collaborate digitally enhances the overall learning experience by exposing students to diverse perspectives, encouraging teamwork, and preparing them for collaborative efforts in future professional settings.

4. Real-World Relevance:

Digital Literacy Integration: Digital literacy skills extend beyond the classroom and are relevant in real-world scenarios. Integrating authentic tasks, such as researching online, creating digital presentations, or collaborating on cloud platforms, helps students apply digital skills in practical contexts (Dangwal, 2017).

Student Engagement: Real-world relevance captures students' interest and emphasizes the practical applications of digital literacy. Engaging in tasks that mirror professional scenarios can motivate students to actively participate in their learning (Kundu, 2018).

Overall Learning Experience: Connecting digital literacy to real-world scenarios enhances the overall learning experience by demonstrating the practical value of acquired skills. Students gain a sense of accomplishment and see the relevance of their education beyond academic settings.

5. Feedback and Assessment Practices:

Digital Literacy Integration: Digital tools enable innovative assessment practices, including formative assessments, online quizzes, and multimedia project submissions. These tools also facilitate timely and constructive feedback (Sanjeevand Kumar, 2007).

Student Engagement: Immediate feedback and varied assessment methods contribute to a positive learning environment. Students receive timely insights into their progress, fostering a growth mindset and encouraging ongoing engagement.

Overall Learning Experience: Effective feedback and assessment practices contribute to an enriched overall learning experience. Students feel supported in their learning journey, and the continuous feedback loop promotes a deeper understanding of digital literacy concepts (Singal, 2006).

In summary, the integration of digital literacy in blended learning environments can significantly impact student engagement and contribute to positive overall learning experiences. The use of technology, when aligned with pedagogical goals, has the potential to create dynamic, personalized, and meaningful educational experiences for students.

4. Discussion

In the context of India, including West Bengal, efforts have been made to enhance digital literacy through initiatives such as Digital India, aiming to empower citizens with digital literacy training. However, challenges persist, particularly in rural areas where access to reliable internet and proper infrastructure may be limited. While schools and higher education institutions incorporate digital tools into teaching, the proficiency of educators and students in utilizing these tools can vary. Skill development programs offer digital literacy courses, but socio-economic factors, including language barriers, can impact accessibility and participation.

In addressing digital literacy challenges, various blended learning models have emerged. These models, such as the flipped classroom, station rotation, flex, online lab, hybrid-flexible, enriched virtual, and project-based blended models, combine face-to-face and online components to foster digital literacy skills. The flipped classroom, for instance, involves students engaging with digital content before in-person classes, promoting digital literacy through online resource evaluation and participation.

Adaptive learning platforms play a crucial role in personalizing instruction for enhanced digital literacy acquisition. These platforms offer individualized learning paths, real-time feedback, dynamic content presentation, adaptive assessments, and data-driven insights. Scaffolding support, progress tracking, gamification elements, integration of multimedia resources, accessibility features, and continuous adaptation contribute to a personalized and effective learning journey.

Professional development programs are essential for educators to integrate adaptive strategies for digital literacy enhancement. These programs provide foundational knowledge, hands-on training, understanding of adaptive platforms, alignment with curriculum objectives, and differentiation techniques. Educators develop data analysis skills, learn to customize learning paths, integrate formative assessments, address equity and inclusion, and participate in collaborative learning communities, ensuring continuous learning and updates.

The relationship between digital literacy integration, student engagement, and overall learning experiences in blended environments is dynamic. Increased engagement through technology, personalized learning opportunities, collaboration, and interaction, real-world relevance, and effective feedback and assessment practices contribute to a positive learning experience. When aligned with pedagogical goals, the integration of digital literacy in blended learning environments has the potential to create dynamic, personalized, and meaningful educational experiences for students, preparing them for the digital age.

5. Conclusion

In conclusion, the efforts to enhance digital literacy in India, including West Bengal, showcase a commitment to empowering citizens through initiatives like Digital India. However, challenges persist, particularly in rural areas where internet access and infrastructure remain limited. Despite these challenges, educational institutions are incorporating digital tools into teaching, emphasizing the

importance of digital literacy for both educators and students. The emergence of various blended learning models, such as the flipped classroom, station rotation, and adaptive learning platforms, reflects a strategic approach to address digital literacy challenges. These models offer a dynamic mix of face-to-face and online components, providing personalized learning experiences and fostering essential digital literacy skills. The flipped classroom, for instance, leverages digital content to engage students before in-person classes, promoting active participation and resource evaluation. Adaptive learning platforms play a pivotal role in personalizing instruction for enhanced digital literacy acquisition. The features of these platforms, including individualized learning paths, real-time feedback, and integration of multimedia resources, contribute to a more effective and tailored learning journey. Additionally, professional development programs for educators are crucial in ensuring they are equipped with the knowledge and skills to integrate adaptive strategies, addressing the varying levels of proficiency among both educators and students. The relationship between digital literacy integration, student engagement, and overall learning experiences in blended environments is highlighted by the positive impact of increased engagement through technology, personalized learning opportunities, collaboration, real-world relevance, and effective feedback practices. When aligned with pedagogical goals, the integration of digital literacy in blended learning environments holds immense potential to create meaningful educational experiences, preparing students for the demands of the digital age. Despite challenges, the ongoing commitment to digital literacy initiatives and the strategic use of blended learning models underscore a concerted effort to bridge the digital divide and promote inclusive, effective education in India.

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Leading Teaching-Learning Together : Role of School Teachers and Their Promotion inevitabitlity

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Abstract

The importance of merit-based promotions, aligning with qualifications and leadership capabilities, cannot be overstated. This approach ensures that the right individuals are elevated to leadership positions, leading to a more diverse pool of educational leaders who can contribute to a dynamic and well-rounded learning environment. Promotion schemes can also serve as a conduit for translating educational policies into meaningful practices at the school level, aligning with the vision of the National Education Policy (NEP) 2020 and the National Curriculum Framework for School Education (NCF) 2023. The varied stakeholders and instructional leaders, who play a pivotal role in system alignment, translate policies into practical guidelines for educators and head teachers, further facilitating their implementation.

Furthermore, periodic performance appraisals, conducted in line with the National Professional Standards for Teachers (NPST), are essential for career progression and recognition, as directed by NEP 2020 guidelines. This abstract, underscores the significance of customized promotions and diversified educator recognition in fostering a holistic and dynamic learning environment, addressing the evolving needs of the school education system.

Keywords : *NCF 2023, NEP 2020, Promotion Schemes, School Teachers.*

Introduction

Elevating the quality of teaching and enhancing learning outcomes requires a comprehensive system of support for teachers and school leaders. Within the educational hierarchy, individuals operating at the intermediate level, bridging the gap between individual schools and central administration, possess a distinctive set of capabilities. These professionals are ideally positioned to foster cooperation, facilitate the exchange of knowledge, expand innovative practices, and offer valuable guidance to educators working at the school level. It reviews a collaborative partnership between the policy framers and the recipients of the scheduled content matter. It focuses on highlighting promising practices globally and is designed to draw out insights and lessons for both policy-makers

and practitioners. It explores how teachers a part of the middle tier are a link for change to improve the quality of education.

Too often, professional teacher development is equated with occasional training courses or stand-alone lectures. In contrast, the work exemplifies a much more mature model of professional learning and support for school improvement which emphasizes need-based or workshop-based training based on peers to reflect collectively on the realities, challenges, and opportunities of their practices through resource sharing. Teachers foster collegiality between professionals and contribute to building a sense of community at different levels of the system. They enhance collective responsibility for educational outcomes by laying out common goals and objectives to affect system change and a mindset shift in the education workforce. The development of a collaborative culture provides a space where teachers and head teachers share successful strategies and 'think together to find solutions to their school issues. This necessarily needs to be intervened and augmented by the coherent policy framing of the current government.

Research Objectives

1. To investigate the impact of government policies on educational inclusivity.
2. To examine the role of teacher promotion schemes in educational quality enhancement.
3. To evaluate the perceived and actual benefits of teacher promotions on professional growth.

Research Design

Based on a qualitative research design, interviews and focus group discussions were employed. Teachers, school leaders, and education policymakers were interviewed to gather in-depth insights into their perspectives on the impact of government policies, the role of teacher promotion schemes, and the perceived benefits of promotions on professional growth. They were allowed to facilitate open conversations, share experiences and opinions collaboratively. These qualitative methods provided a rich understanding of the complex dynamics involved in teacher development and educational policies.

Review of Related Literature

Dinham and Scott's (1998) paper introduces a three-domain model of teacher and school executive satisfaction, based on a survey of 892 respondents in 71 government schools in Western Sydney. The model encompasses factors such as school leadership, climate, decision-making, and merit promotion. Results highlight variations in satisfaction levels across core teaching, school, and societal factors, emphasizing the significance of school-level actions in enhancing teacher satisfaction. The paper of *George and Shari (2018)* provides insights into the needs and challenges surrounding the promotion of school teachers. The abstract delves into the complexities of teacher promotion, likely discussing key factors such as qualification alignment, leadership capabilities, and the broader context of educational policies. It serves as a valuable resource for understanding the nuanced requirements and considerations in promoting teachers within the school system. The study of *Nalova (2016)* investigates the perception and outcomes of automatic promotion in Cameroon's primary schools,

emphasizing potential discrepancies in its implementation. Through a survey involving 275 teachers and examiners, findings indicate a negative perception and inconsistencies between the intended concept and its execution, potentially contributing to a decline in educational quality. The study recommends addressing the discrepancies to enhance the effectiveness of automatic promotion and improve overall educational quality.

Necessity of Government Policies

Government policies can address disparities in access to quality education. By formulating policies that ensure equitable access to education for all socio-economic and demographic groups, the government can reduce educational inequalities and promote inclusivity. Policies are essential for setting and maintaining high standards of education. Governments can establish guidelines for curriculum development, teacher training, and assessment practices to enhance the quality of education provided in schools and ensure that students receive a valuable learning experience. Education systems need to adapt to changing societal needs and technological advancements. Government policies can foster innovation in teaching and learning, encouraging the integration of modern pedagogical methods, technology, and vocational education to meet the demands of a dynamic job market. The government policies provide the framework for accountability in the education system. Policies can establish assessment and evaluation mechanisms for schools and teachers, ensuring that they are held accountable for their performance. Transparency in educational governance is essential for building public trust in the education system. In the context of shaping educational policies, accountability on both policy framers and curriculum transactors plays a crucial role in ensuring the effective functioning of the education system. Thereby manipulation of individuals for perceived greater good often invokes the concept of 'Benevolent Paternalism,' which involves decision-making with the best interests of individuals in mind, even if it means influencing their choices and autonomy.

Benevolent Paternalism for Policy Initiation

Defining the concept

When discussing the manipulation of people for what is perceived as the greater good, one psychological model that is often mentioned is "Paternalism" or "Benevolent Paternalism." Paternalism involves a person or group making decisions or exerting control over others with the belief that they are acting in the best interest of those individuals, even if it involves limiting their autonomy or manipulating their choices. This model can be controversial, as it raises ethical questions about who gets to define what is the "greater good" and how much manipulation or control is justifiable.

It's important to note that the use of paternalism for the greater good is a complex and debated topic in ethics, psychology, and philosophy, and it often depends on the specific context and the values of the individuals or society involved. Some may argue that certain forms of paternalism can be justified in situations where individuals may not make decisions in their own best interests, while others may emphasize the importance of individual autonomy and informed consent. The ethical

considerations surrounding paternalism and manipulation are central to discussions in fields like bioethics, public policy, and psychology.

In education, benevolent paternalism informs curriculum standards and regulations to nurture students' academic learning growth. In management, it guides HR policies for employee well-being and collective organizational success.

Managerial Interventions

The company managers provide incentives to employees that not only benefit the company but also lead to the self-improvement and skill enhancement of the employees, aligns with several management and motivation models. Like the *Self-Determination Theory* (SDT) proposed by Edward L. Deci and Richard M. Ryan (1985) suggests that people have innate psychological needs for autonomy, competence, and relatedness. When managers design incentive systems that support these needs, employees are more likely to be intrinsically motivated, leading to not only improved performance but also personal growth and skill development. *The Transformational Leadership model* proposed by James MacGregor Burns (1978) suggests that transformational leaders inspire and motivate employees to achieve exceptional results by setting high standards, encouraging personal growth, and fostering a sense of shared vision and purpose. It's particularly effective in organizations that value innovation, creativity, and personal development. The *Goal Setting Theory* exhibited by Edwin A. Locke (1968) states that managers can use this theory to set clear, specific, and challenging goals for employees. It is particularly useful when employees need to develop new skills or improve their performance, as it can lead to personal growth and increased job satisfaction. Moreover, *Job Enrichment and Job Rotation* schemes as laid down can be applied in a wide range of organizations and industries and beneficial when employees seek more engaging and challenging work. They can enhance skills and job satisfaction, especially in roles where routine tasks can become monotonous. The *Incentive Compensation Models* are used in various sectors, including finance, sales, and technology, and can also be particularly appropriated in the education system. Profit-sharing, stock options, and other financial incentives can motivate employees to improve their performance and contribute to the company's success. They are particularly effective when employees are motivated by financial rewards and the opportunity to share in the company's prosperity. Such issues arise when education is being considered as an investment and an agent for the economic development of a nation. *360-degree Feedback and Continuous Learning*are valuable in organizations that prioritize employee development and continuous improvement. 360-degree feedback is beneficial for personal growth, as it provides employees with a well-rounded view of their strengths and areas for improvement. Continuous learning is relevant in industries and in education where skills and knowledge need to be constantly updated. Similarly, the *Total Rewards Approach* in organizations values employee well-being and work-life balance. It considers both financial and non-financial rewards, such as career development opportunities, recognition, and work-life balance. This model can be effective in retaining and motivating employees who prioritize a holistic approach to compensation and personal growth.

The applicability of these models may vary depending on the organization's culture, industry, and the specific goals and needs of its employees but currently, these can be systematically applied in the context of educational management and administration of a nation. The stakeholders involved in policy design aim to efficiently gather the best outcomes from those involved within a minimal timeframe, while striving for maximum results.

Sociological Infusions

Sociological theories also provide a comprehensive framework to understand how education interacts with society. For enabling national development government ventures as laid down in different policies need to be constituted in a tailored frame for addressing the issues in a befitting manner.

Max Weber, a German sociologist, is known for his contributions *Weberian Model (1904)*in the field of sociology, particularly in the areas of bureaucracy, rationalization, and the study of social action. The Weberian model is often used to understand how bureaucracies and organizations function, emphasizing concepts like the ideal type of bureaucracy and the impact of rationalization on modern society. Weber's work has been influential in understanding the role of authority, power, and social structures in society. Weber's insights into rationalization can inform the structured implementation of the promotion scheme, ensuring a methodical and logical approach to career advancement for teachers and also guide the establishment of clear lines of authority in the promotion process, fostering transparency and fairness in teacher advancement.*Émile Durkheim,* a French sociologist, is renowned for his work titled *Durkheimian Model of social integration and the study of anomie*(1893). The Durkheimian model is often used to examine the relationship between social cohesion, social norms, and the prevention of deviant behavior in society. Durkheim's ideas have had a significant impact on the field of sociology, especially in the context of understanding how social forces and institutions influence individual behavior and well-being. Durkheim's ideas encourage and foster collaboration and a sense of belonging among teachers, enhancing overall school cohesion. The novel government initiative would discourage deviant practices and ensure teachers adhere to established educational norms, contributing to a positive and ethical school environment.

Psychological Rationale

Freudian Psychoanalysis (Sigmund Freud)in 1896 offers valuable insights for management models. It helps managers understand employee behaviour, motivations, and conflicts by considering the influence of past experiences. Freud's concepts, such as the id, ego, and superego, provide a framework for addressing conflicts and motivating employees effectively. Recognizing individual differences in personalities and defence mechanisms allows managers to tailor their leadership and management approaches to meet their team members' diverse psychological needs. Similarly, the government (employer)can also lay down schemes to develop strategies for motivating the teacher community effectively and boost them for better performances with their responsibility.

Jean Piaget's Theory of Cognitive Development work emphasizes the role of schema development, assimilation, and accommodation in understanding how individuals acquire knowledge and understanding about the world. Teachers at various cognitive stages may require different forms of professional development, aligning with their cognitive readiness for effective teaching problem-solving, and teamwork. Moreover, to tailor the skill-building, and training programs, and enhance the capabilities and teaching methods of the school teachers, the promotion scheme would be beneficial. The career and performance appraisals would be upgraded and updated, thereby the directives which lay inert in reports would be active in reality. Consequently, the young learners would benefitfrom their lesson transactors for their holistic future development.

Supporting The Policy

The above multidimensional theories lay hidden beneath the agenda of governmental initiatives to implement the scheme for creating school teachers' promotions (similar to *assistant, associate, and professor in college/higher education*). Year after year policies-bunches come into vogue to exalt the process of teaching-learning at the school level, but, the teachers, as usual, remain unaware, hardly abide by them, and above all, ignore them simply. The National Education Policy (NEP) 2020 suggests major directives for school education to promote the school teachers and their transaction in the institutions. However, to augment the implementation and follow-up of this recent governmental policy, a catalyst has been introduced in this context. It not only paves into monetary increment but also vehemently endows school students. There is adequate rationality in supporting the policy of school-teacher promotion.

Promoting teacher promotions in school education, similar to the tiered system used in college/higher education (assistant, associate, professor), can have the following ensured benefits for a positive move to improve the teaching-learning process:

Encouragement for Professional Growth: The introduction of a promotion system creates a clear career path for teachers. It encourages them to invest in their professional development, acquire advanced degrees, attend workshops, and engage in continuous learning. As teachers progress through these stages, they are more likely to be motivated to enhance their skills and knowledge. Furthermore, when teachers effectively transfer their learning, it leads to enhanced student learning and growth.

Recognition and Reward: Teacher promotions provide formal recognition of a teacher's experience, expertise, and contributions to the education system. Such recognition can boost a teacher's morale and job satisfaction, as they see their efforts acknowledged and rewarded. This can result in increased dedication and motivation to improve their teaching methods.

Enhanced Quality of Education: Teachers who have advanced in their careers through promotions are likely to bring a higher level of expertise to the classroom. This, in turn, benefits students by exposing them to more knowledgeable and skilled educators. The improved quality of instruction can lead to better learning outcomes for students.

Leadership Opportunities: As teachers progress through promotion levels, they can take on more significant roles within the school system, such as mentorship, curriculum development, and administrative responsibilities. This contributes to the overall improvement of the educational institution and enforces community commitments.

Attracting and Retaining Talent: A clear promotion structure can make the teaching profession more attractive to talented individuals. Knowing that they have the opportunity to advance their careers and receive recognition for their efforts may entice more individuals to become teachers and encourage them to stay in the profession.

Accountability and Evaluation: The promotion system can be linked to performance evaluations and assessment of a teacher's impact on student learning. This ensures that promotions are based on merit and encourages teachers to continually improve their teaching methods and effectiveness.

Improved Teaching and Learning Environment: With a promotion system in place, there is a structured mechanism to identify and reward exceptional teachers. This can create a culture of excellence within schools, motivating all teachers to strive for better performance, leading to an improved overall teaching and learning environment.

Alignment with Higher Education: Having a promotion structure akin to that in higher education helps bridge the gap between school and college-level teaching. It promotes consistency in expectations and standards for educators, which can be particularly beneficial for students transitioning from secondary to higher education.

Global Alignment

Promotion systems for school teachers worldwide aim to recognize, motivate, and foster professional growth. They vary significantly among countries on the global platform. The United States acknowledges experienced teachers with titles like "Master Teacher or "National Board Certification.", whereas Finland advances teachers from "class teacher" to "senior teacher" based on experience and professional development. The UK provides career advancement opportunities such as headteacher or deputy headteacher, while Singapore offers higher compensation for leadership positions like "Lead Teacher,"with a higher salary. In Australia, teachers can advance through various levels based on their qualifications and teaching experience. Japan emphasises on subject specialization, and Canada on mentorship as "resource teachers". In the Netherlands, teachers can achieve "senior teacher" status after demonstrating excellence in teaching and contributing to educational innovation. Sweden recognizes "specialist teachers" title for excellent performance. South Korea maintains accountability through rank-based progress, highlighting the diversity of global approaches to promoting educators.

Concerned Professional Yardstick

General professional standards for school teachers, in alignment with the National Education Policy 2020 (NEP 2020) and the National Council for Teacher Education (NPST), encompass diverse

competencies. These include pedagogical competence, subject matter expertise, promoting socio-emotional learning (SEL), creating inclusive and diverse classrooms, engaging in Continuous Professional Development (CPD), upholding ethical conduct, fostering leadership and collaboration, participating in community engagement with stakeholders, nurturing innovation and creativity, and undergoing regular performance appraisals. These standards ensure teachers are well-prepared to provide holistic and quality education, meeting the evolving needs of the education system.

Empowering Teacher Types

The concept encapsulates the idea of tailoring promotion schemes to uplift educators such as innovators, mentors, subject specialists, and leaders with various strengths and expertise, ultimately fostering a holistic and well-rounded educational experience for students. The package may be divergent for different categories:

- **Innovative and Engaged Teachers:**

Recognition and Encouragement: Promotions can recognize and reward innovative and engaged teachers for their creative teaching methods and commitment to enriching the learning experience.

Leadership Opportunities: Promotions may lead to leadership roles within the school, where these teachers can influence curriculum development and pedagogical approaches, fostering an environment of continuous improvement.

Increased Impact: As they move into higher positions, they can have a more significant impact on the school's educational practices and policies, allowing them to further promote innovative teaching methods.

- **Adaptive and Resourceful Teachers:**

Professional Growth: Promotions can provide opportunities for further professional development and training, which can enhance their ability to adapt to diverse teaching environments.

Increased Access to Resources: Higher positions may grant more authority to acquire and allocate resources, allowing them to support their colleagues in using resources more effectively.

Leadership in Resource Management: They can take on leadership roles in resource management, helping the school optimize its resource allocation strategies.

- **Highly Satisfied and Motivated Teachers:**

Validation of Dedication: Promotions can validate their dedication to teaching and provide a sense of recognition and accomplishment.

Mentorship and Guidance: Higher positions may enable them to become mentors and guides for newer teachers, passing on their enthusiasm and commitment to the profession.

Influence on School Culture: They can have a positive influence on school culture by promoting values of job satisfaction, well-being, and a sense of purpose among colleagues and students.

- **Teacher Leaders and Change-Seekers:**

Increased Leadership Opportunities: Promotions can offer formal leadership roles where they can spearhead initiatives, shape school policies, and drive positive changes.

Influence on Educational Practices: They can have a broader impact on educational practices, such as curriculum development, teacher training, and student engagement strategies.

Enhanced Capacity for Change: Higher positions provide greater capacity to advocate for and implement changes that align with their vision for improving education.

Assessment Criteria for The School Teachers

Implementing cash and honor incentives for school teachers in India aligns with various benefits. These incentives serve as a powerful means of recognizing and motivating teachers, which can positively impact their job satisfaction and commitment. In the context of India, where quality education is crucial, these incentives help attract and retain high-quality educators, ultimately enhancing the overall quality of education. Furthermore, promotion schemes often require teachers to engage in continuous professional development, which aligns with the criteria of assessment for teachers in the Indian context. This professional growth, coupled with the potential for increased financial rewards, can contribute to improved teaching practices and student outcomes. Additionally, these incentives help in retaining experienced teachers, which is particularly important for India, where teacher retention can significantly impact educational stability and success. The suggested format for assessing and promoting school teachers may be taken into consideration:

Peer Reviews: Colleagues and supervisors should provide feedback on a teacher's performance. Peer reviews assess teaching skills, collaboration, and the ability to contribute positively to the school community.

Student Performance: Student outcomes, such as academic achievements and socio-emotional development, should be considered. Teachers who consistently facilitate student growth and success should be recognized.

Attendance and Commitment: Dedication to teaching, including regular attendance and active involvement in school activities and initiatives, should be assessed. Teachers who demonstrate commitment to their roles should receive recognition.

Professional Development: The number of hours spent in Continuous Professional Development (CPD) and the quality of CPD engagement should be evaluated. Teachers who actively pursue professional growth and stay updated on the latest pedagogical approaches should be acknowledged.

Community Engagement: Involvement in community activities, such as parent-teacher interactions and community development projects, can be assessed. Teachers who make significant contributions beyond the classroom should be acclaimed and documented.

Innovation and Creativity: The ability to implement innovative teaching methodologies, like experiential learning, arts integration, sports integration, and storytelling-based approaches, should be considered. Teachers who bring creativity into their teaching should be rewarded.

Leadership Skills: For career growth and leadership positions, teachers should demonstrate leadership and management skills. These skills can be assessed through workshops, certifications, and successful management of school-related projects.

Professional Ethics: Adherence to ethical standards in teaching, including fairness, integrity, and maintaining a safe and inclusive environment for all students, is essential. Teachers should be assessed on their ethical conduct.

Performance Improvement: A history of consistent improvement in teaching performance over time can be a valuable criterion. Teachers who show a commitment to growth and adaptation in their roles should be acknowledged.

Mentoring and Guidance: Teachers who mentor and guide junior colleagues or support fellow educators in their professional development should receive recognition for their contributions to the growth of the teaching community.

Feedback from Stakeholders: Collecting feedback from students, parents, and colleagues about a teacher's impact can provide valuable insights into their performance and contributions to the educational community.

Targeting Student – Community Turnover

The implementation of cash and honour incentives for teachers plays a pivotal role in elevating the overall standard of education and subsequently enhancing the educational experience for students. These incentives, when well-structured, not only motivate and retain high-quality educators but also lead to higher-quality instruction. Reduced teacher turnover ensures students benefit from consistent, experienced teachers, familiar with their needs. Moreover, these incentives often come with requirements for teachers to continually improve their skills, fostering ongoing professional development and innovative teaching methods. Recognized and rewarded teachers can serve as inspirations for students, promoting excellence in their education and contributing to an improved school reputation, which can, in turn, attract more students and resources. However, it's vital to underscore that while incentives are valuable, they should complement a comprehensive approach to educational enhancement, which includes aspects like teaching quality, curriculum, infrastructure, and parental involvement, creating a holistic and effective learning environment that nurtures student development.

Conclusion

For decades there has been a status quo in the condition of school teachers in India.

Implementing the promotion scheme marks a paradigm shift, moving from decades of paper-based reports to actionable, community-centric initiatives. Promotions should be merit-based,

fostering diverse educational leaders. The National Curriculum Framework (NCF) 2023, aligned with NEP 2020, addresses translating policies into effective school practices. Instructional leaders play a crucial role in this alignment, making policies more accessible for educators. Periodic performance appraisals, in accordance with the National Professional Standards for Teachers (NPST), are vital for career advancement, as directed by NEP 2020, ensuring a holistic and dynamic learning environment.

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Apollo and Pythagoras at the Juncture of Mythical, Rational, Ancient and Modern

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Abstract

Pythagoreanism, a cult of the 530s BCE, is shrouded in mystery and very few accounts of their secretive knowledge have been passed down to us. These worshippers of the sun god Apollo were some of the first mathematicians, scientists and philosophers. What current researchers do know of them presents a stunning picture of the advanced experimental and calculative nature of Classical Greece. The figure of Apollo helms the proposition of several radical ideas in the fields of mathematics, philosophy and music, providing a bridge between the divine religious abstract and the rational observable reality. Much of our current knowledge is built upon the Pythagoreans' works, who saw the language of the universe in mathematics and translated it through music, art, justice systems and more. This essay analyses the connection of the mundane with the arcane through the core essence of numbers, with specific focus on the Pythagoreans' study of the world.

***Keywords*:** Ancient Greek literature, Apollo, Classical Greece, Divin Pythagoreanism, Philosophye, Rational

Introduction

A modern scientist will explain that the language of the universe can be found in mathematics. Every process in nature can be compiled into formulae and understood through numbers. If Physics shows the laws of cosmos, Chemistry the composition of cosmic creations, and Biology the rules that

these creations follow, then they all can be assimilated under the umbrella that is Mathematics. Mankind's progress is written in the development of mathematical studies. The growth of our civilization lies in the hands of mathematics, and those who water that plant of numericals with newer approaches everyday.

In analysing the universe and our world with this modern scientific outlook, one tends to forget to look back. Even when they do, they don't ponder far enough. The understanding of science comes from the rudimentary sense of modern development. Nothing beyond a few centuries interests modern minds when they ask, "What has mankind achieved as a species that can read and experiment?" This partial look back creates a void in the understanding of human history: one sees humans start as savage beings drawing animals on cave walls, then building cities in the name of invisible gods, to become a species that rapidly furthered its knowledge through hypotheses and research. Human history is not such a simplistic territory: the stage for science was set at the same time when cities built temples larger than themselves in the name of invisible gods.

Here, one comes back to mathematics. And with the numbers comes the cult that impacted the way mathematics is known: Pythagoreanism.

Pythagoras is quite a familiar name. The theorem in his name is taught to students across the world in schools. In calculating how long the hypotenuse of a right angle triangle would be, one does not exactly think of a cult, or music and poetry. And when scholars discuss cults, mathematical or scientific progress isn't the first idea that occurs. Pythagoreans smother all those notions. Instead, they offer a view of the universe that is truly well ahead of their time, and has since been forgotten.

Academia is quick to divide mathematics, music, poetry and art into their own domains, albeit admitting there is some connection between them. But it would be grave injustice to read a poem or study a song without giving thought to the math behind it. Pythagoreans accepted this relationship, and they rightly bestowed the prowess of these elements on one god: Apollo.

Apollo: The mathematical god

The pantheon of Greek mythology is replete with gods, but few hold as much sway in modern society as Apollo. From space probes to theatres to tyres to medicine companies, the name is all around us. And it is rightly still crowned with popularity. Apollo was considered the paragon of perfection. He drove the sun chariot, shot arrows with perfect precision, caused ailments and healed them, prophesied the future, mastered the art of music, poetry and painting, upheld justice, and even possessed the perfect physical proportions. Above all, he was the god of mathematics. In attributing all these to the blonde god of rare handsomeness, the Ancient Greeks displayed an understanding of the universe that still is impressive.

Modern medicine, for instance, uses the staff of Hermes as a symbol that intends to represent the staff of Asclepius, the son of Apollo and the god of doctors. The Apollo Pharmacies across India are a call back to the god's expertise in medicine and healing. The Apollo mission sent to the moon is a cool

play on Greek mythical names: Artemis, his twin sister, represents the moon, and the Apollo spaceships go out to research the moon, in a way "checking up on" his sister. Similar naming is also found in Jupiter and its moons, named after the various consorts of Zeus/Jupiter. The space probe sent to the planet was, quite fittingly, named Juno, the wife of Jupiter in myths.

Exactly when and how Apollo got attached to the all the elements attributed to him, one cannot say. Much of the Pagan records were destroyed to de-establish their status quo. And cults like the Pythagoreans were extremely secretive. What modern scholars know of ancient philosophy and science are found in fragments, excerpts, refutations and quotations. And from these, one can understand that Pythagorean worship of Apollo had a lot to do with his attributions.

Pythagoras and his cult

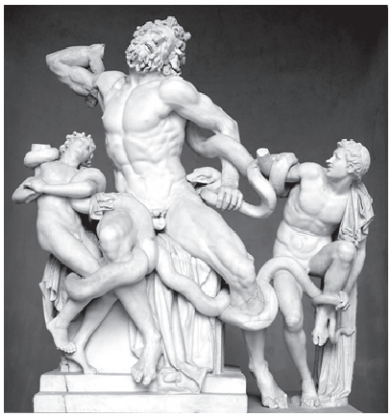
Little is known of Pythagoras himself. Common knowledge is that the Pythagoras theorem already existed before he was born. In fact, it can be found in Ancient Mesopotamian records. But that doesn't take away from his merit. The lack of development on the theorem until Pythagoras has much to do with the implications of irrational numbers, more on which has been discussed later. Through contacts with India via Arab, Pythagoras and his followers became masters of mathematics. They observed nature to draw conclusions. They conducted experiments to understand the why's of nature, instead of merely seeing them as vague messages from the divine. They proposed that the sun was a ball of fire, earth a sphere, and the stars other balls of fire, but too distant to make their heat feel like the sun. The sun's precise movement across the sky and the routine of its rise and fall throughout the year created a sense of stability. And this stability, according to Pythagoreans, comes from the fact that mathematics itself is a stable subject, and therefore it must be the language of the universe.

According to Pythagoreans, the world is composed of opposites: heat/cold, dry/wet, and so on. The key to understanding these opposites lies in mathematics. Their motto was "All is number" or "God is number". For instance, to them the even numbers represented the infinite, as when they are halved again and again, the final result is always 1. The even numbers were male. The odd numbers represented the finite, because they were not divisible as even numbers, and female. The number 5 signified marriage, as the sum of 2 and 3. It has strong influence of the gender dynamics of the time. Given that women held a lower position in Archaic societies and the Pythagoreans were strictly abstinent, this attribution makes sense. The inequality is paradoxical, though, as the Greeks believed in the supreme unity of the Universe, represented by the number 1. And Gaia, as the primordial mother goddess, bore children without the help of Ouranos when he tried to oppress her. Gaia's myth has heavy allusions to the pre-existing tribal mother goddess, and despite her reign as the gift giving earth goddess, she and all women are less than men for the patriarchal Greeks.

The Pythagoreans derived that the universe had originated from Chaos (καος), a concept which Ovid later propagated, and the earth and other heavenly bodies were arranged in an order only when complex mathematical relations came to play. Instead of Gaia in the myths, Chaos was followed by mathematical order. Chaos is similar in representation to the Big Bang, and was an overarching myth in Antiquity, there being similar stories in the *Rigveda* and *Corpus Hermeticum.* The order in which the Cosmos fell after the Big Bang exhibits itself in everything around us, because they all create one unit: The Universe. Pythagoreans gave immense importance to the number 1. They saw 1 as the generator: the number from which all other numbers arise. Even though there are allusions to multiverses or multiple realms, the idea of one Cosmos and our singular existence gave way to 1 being crowned as the genderless prime. All things that can be measured, in the eyes of Pythagoreans, must have a dimension equal to or greater than 1. Again, the discovery of irrational numbers created a completely new notion of the numbers, and that will be discussed later.

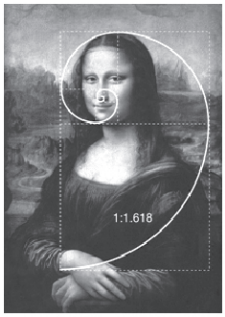
The math of art

To better understand the mathematics of the universe, they attached the concept of music and art to it. Music and poetry, which were often performed as musical poetry in Classical Greece, had an identifiable pattern of beats and rhythm. They believed that music has the same effect as medicine on the human body, a theory proven true in some parts today. The Ancient Greeks saw poetry and music as abstract and divinely inspired. Therefore the perfection in music through mathematics gave them a bridge between the divine and the mundane. This principle became highly important, as it was seen as a means to imitate and reach the gods themselves. The precision of mathematics in nature was to be imitated in music and art so as to make them perfect, and this principle plays into the excellent Greek sculptures that exist today. The attempt to imitate reality in its perfection returned during the Renaissance, when artists like Michaelangelo and Leonardo da Vinci employed heavy use of math to paint divine or mythical scenes.



Renaissance painters, especially the Humanists, followed this principle and changed the face of art. To them, merely telling the story of a myth is not enough. To truly capture the divine essence in the most real way possible, it was essential to imitate (mimesis) the scene to perfection. The reproduction of a three dimensional form on a two dimensional plane required not just mathematical calculations, but also numerical illusions. For instance, in Raphael's *School of Athens*,

[1] Optical Refinements at the Acropolis.
1: Parthenon
5: Gateway building or Propylaea
16: Erechtheion



all the human figures are painted as if they are seen from the front, kept equal in size, despite the receding orthogonal lines. Below is a representation of this:

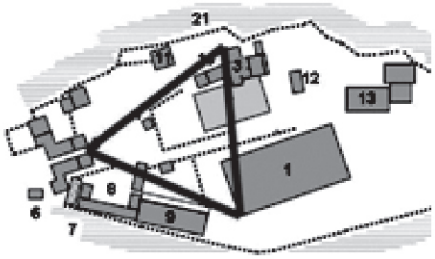
Using the geometrical discoveries of the Pythagoreans, the Ancient Greeks built monuments of precise mathematical order. Perhaps the best example is the Parthenon in Athens: an example of the fine architectural achievement of the Greeks. Each pillar of the Parthenon is designed using optical refinement to look organic by thickening them at the base, while also ensuring they were strong enough to hold the ceiling in place. The façade of the temple used the Golden Ratio (1:1.618). The Caryatid is yet another fine example.

1: Parthenon

Pythagoreans were also the first to experiment with strings to create music. AC Grayling writes,

"The mathematician Aristoxenos said that Pythagoras was the first to take the study of arithmetic beyond the practical needs of commerce…the pitch of a musical note depends on the length of a string whose vibrations produce the note, and that simple numerical

ratios explain the consonant intervals of the scale: 2:1 octave, 3:2 perfect fifth, 4:3 perfect fourth, and so on. To understand this, think of two guitar strings of equal length, tension and thickness. If they are both plucked together they sound the same. If different lengths of each are plucked, they sometimes sound dissonant and sometimes consonant. This latter observation underlies measurement of consonant intervals – an interval being the distance between two notes, and a consonant interval being one in which the two notes sound good together. Experiment will show that if you have two lengths of string of equal length, tension and thickness, plucking one while



A close-up of the pillars of Parthenon, Athens, built:447 and 432 BC. The shape of the column shafts, and their slight tilt from the vertical, are said to correct optical distortions so that the building appears to be perfectly regular. The columns taper towards the top, but also swell slightly part of the way up, to avoid an impression of narrowing at the centre.

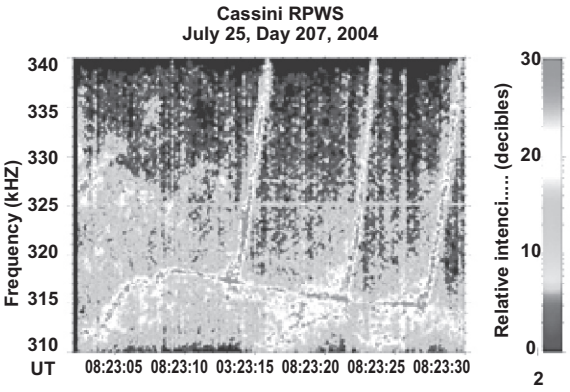
simultaneously plucking exactly half the length of the other will yield a consonance – this is the octave."

Music and poetry both employ metres: the key to make them sound pleasant to the ears. Art uses patterns to please the eye. Although not many paintings from Classical Greeks survive, those that do show impeccable mathematical abilities of the artists. Take vase paintings, for instance. The vase was an non-uniform surface to paint on, but the figures painted on it required to be decipherable and realistic. So illusions of mathematical trickery were used to paint the mythical figures. The peak of Greek art was achieved in the bronze and marble sculptures, which made even the solid material look fluid. The statue of Apollo Belvedere, for instance, shows the god's muscles in a state of rest, and thus show how fit he is even when he is casually posing. The attitudinal representation of *Laocoon and his Sons* allowed the Greeks to show the taut muscles of men in agony. The principle of attitude was thus used in art for showing off the skill of the artist, and this required calculated work. The Renaissance returned to this trend, like in *The Birth of Venus*.

The art of music evolved to become the tradition of dramas because of Euripides, Sophocles, Aeschylus and more. Both tragedy and comedy were born in musical performances, and the epic poems were sung before an audience. The Muses were said to have inspired these myths among the authors, and thus music became divine. In fact, music is as old an art form as paintings. The Pythagoreans came in, saw the role of mathematics in music, and exalted both by making music the means to reach the gods.

Astronomical developments of the Pythagoreans

This mathematics of music, they took to the planets, proposing the idea of *harmonia*or harmony. Because everything in nature is mathematical, and is created by the Universe, the connect between the mundane and the divine must be mathematics. While the mathematics of trees or rocks or days could be observed up close, the planets they saw in the sky could not be studied so. The inference is drawn out of a simple logic, if mathematics is in nature as well as music, then planets, also natural creations, must exhibit musical qualities. Not just this; for the world to exist there needs to be order, and harmony is the mathematical display of this order. In fact, the idea of entropy heavily depends on the existence of ordered law, and therefore both creation and destruction are calculable ideas. According to them, planets are arranged in a concentric series of paths, and every planet emits its own music based on its size, position and so on. Today, this has been proven to some extent thanks to the various space probes sent out to space: "In 2022, people on Earth were able to hear the planetary sounds of Mars thanks to two microphones installed on board NASA's Perseverance rover…The planetary sounds we hear, are wavelike vibrations of air molecules occurring within the range of frequencies to which our ears are sensitive, according to the BBC …it's possible to process any other kind of wave or oscillation electronically, scaling it to audible frequencies and then converting it into a sound wave…The process of turning non-acoustic data into audible sounds — called sonification — can have benefits for astronomers involved in analysing the data, according to Scientific American."



Pythagoreans suggested that the moon has no light of its own, but merely reflects the light of the sun. They held the opinion that beyond the known planetary system, there are other planetary systems as well, with their own suns. They also proposed the revolutionary idea of reincarnation: Metempsychosis. This was possibly an influence of Indo-Greek exchange of ideas as well, but for Europe this was a first. Pythagoras deeply supported the idea that good deeds can help one transcend the cycle of rebirths to reach the divine, something the Vedas and Buddhist philosophies also support. The Pythagoreans were constantly learning about eastern philosophies and scientific works: they borrowed 0 from India. So it is no surprise that the notion of rebirth also impressed them. It must be noted here that Pythagoras is reported to have been very strict about this phenomenon: he did compel his followers to treat all animals kindly, and become vegetarians, but he also believed that human souls can be reborn in beans. Such eccentricity is not uncommon among ancient philosophers, but in one regard Pythagoras was right: plants do have life like animals, a theory later propounded and developed by JC Bose.

The intersection of the divine and the mundane

The work of the Pythagoreans in understanding the world through mathematics closely linked the belief system around Apollo. It was previously mentioned that Apollo is the god of prophecies in the Greek pantheon: he alone has the power to foresee events in the future that are bound to happen. Even in this, mathematics plays a vital role. Astronomers today can make complex calculations to understand the age of the universe, how long the sun will last, and predict cosmic events at a time scale that the human mind can hardly comprehend. For instance, by studying the weather and climate of a place in the past, scientists can build a mathematical model that would allow them to predict the weather in the upcoming days. Such formulae are also used to predict how the sun will age and when it becomes a Red Star, how far it will expand. Pythagoreans recognised the possibility of building such numerical models, although they themselves could not make astronomical predictions with modern accuracy. Thus, it would not be a mistake to say that mathematics is the key to seeing the future, at least when it comes to events that are inevitable. Here, Grayling calls for the mention of Thales, a contemporary of Pythagoras. Grayling recounts:

"When Thales was criticized for his poverty he said nothing, but studied the weather carefully until, one year, he was able to predict that there would be a glut of olives. Before this became obvious to anyone else he rented all the olive presses in Miletus, and rented them back at a premium to their anxious owners when the latter came begging for them. Aristotle says, 'In this way he proved that philosophers can easily be wealthy if they wish, but that is not what they are interested in.'"

[2]Saturn's radio emissions, which have changes in frequency (127Kb Wave Sound).

The Pythagoreans thus advanced mathematics to such extents that today modern scientists can create complex calculations and break barriers to decipher the cosmos. They proposed the wondrous nature of the number 3, the number of harmony, and borrowed from the Indians to propagate arithmetic based on multiples of 3. They formed their own system of counting using "figures", a term still in use when talking about numbers. They gave the word *theorein*, from which the word theory is derived.[3]

The role of *mimesis* has already been discussed. Now one has to take a look at the role of cults in Ancient Greece with respect to Pythagoreans. Cults were commonplace in the Classical Age: one of Dionysus existed that followed the non-heteronormative nature of the wild wine god; another of Demeter and Persephone existed in Eleusis, who revered earth's fertility and the routine of seasons. Unlike modern cults, ancient cults saw religion as a means to study the world instead of rejecting scientific objectivity. Pythagoreans were cultists, but also scientists and mathematicians. They saw in Apollo not a mysterious display of natural phenomena, but an opportunity to scale the world. Worshipping Apollo was not a refusal to calculate the world, but immersing in studying the world in a secular manner. Like the poets saw the Muses as their inspiration, so the Pythagoreans saw Apollo as blessing their ventures.

The domestic as well as the political machinery employ math: for instance, how much grain can feed a family of four for a month, or an army of four hundred men for a week What if one of the family members leaves, or three hundred more men join the army The requirement of grains can be calculated with a mathematical formula. As the god of Justice, Apollo represents the importance of math in the running of the State. Not only would convicting an innocent man prove the incapability of the government, but also the business structure of a State's treasury ensures its prosperity. Apollo inspires people to seek retribution and provide justice; the Court of a monarch in the kingdom represented this system of punishing the criminal rightly to keep the State running smoothly.

Apollo was a god who spent his days playing music and creating poetry, but when the time called, he was an excellent ally to have in war. In this, Pythagoreans recognised the mathematics of war. From the use of weaponry to formation of armies, called *strategia,* the use of mathematics can help a warrior win even with limited resources. The accuracy of an arrow depends on the calculations that go into shooting it, and Apollo is a master of both. Modern weapons use mathematical equations to shoot missiles, which again depend on satellites built through math. Even though guns have replaced arrows, Apollo's influence on warfare remains.

Apollo is also said to have shot arrows of plague towards the

[3]AC Grayling, *History of Philosophy*

enemy, and use his skills in medicine to heal his worshippers. Modern medicine is heavily dependent on mathematical calculations, and this must have held true for the Pythagoreans as well. They could observe the calculated precision required to concoct a medicine: how the excess or lacking of an ingredient could change a medicine from potent to poisonous. They could also have seen the relation between weather and disease. Thus a proper calculation of weather could tell them if they would be plagued by disease or spared. The plague would also depend on location, and Pythagoreans were heavily engaged in calculating the earth's size and where various states were located on the surface of the earth. The relation between music and health is also another proof of how well they understood the importance of math in everyday life. Patients of dementia are often told to listen to music to help their nerve cells, and the mathematical patterns of a song help regulate the body's blood flow. Pythagoras is attributed to have first discovered the link between music and wellness of mind.

According to scholars: "One day, (Pythagoras) was passing by a blacksmith, and suddenly, he noticed the sound of a hammer and found it to be musical. He rushed inside the shop and started beating hammers of different sizes on the table. He observed that the tune played by the hammer was directly proportional to the size of the hammer, hence he proved that music was mathematical."

Most modern music uses the rhythm of 4/4 to create the sense of pattern. This creates a sort of harmony in all pleasant music. As the lyrics of one song goes:

I say certified freak

1 2 3 4

Seven days a week…

1 2 3 4

Or, in another song:

I'm a Barbie girl

1 2 3 4

In a Barbie wo-orld

1 2 3 4

Life in plastic

1 2 3 4

It's fantastic!

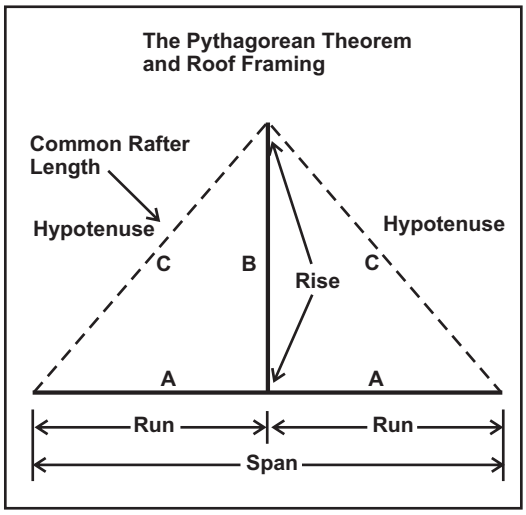
1 2 3 4

The tempo of a song can also be calculated on the basis of how many beats per minute are played for each verse. A metronome is used for this. For example, a slow song that wishes to convey a romantic mood, like *Until I Found Her* by Stephen Sanchez has 70 beats per minute, while a FIFA theme song like *Waka Waka* by Shakira can use 200 beats per minute to convey the speed and adrenaline rush of a football match. Party songs have higher beats per minute, while sad songs have lower beats per minute.

The Pythagoras Theorem

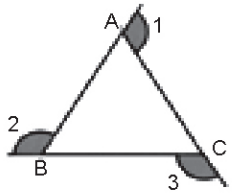
$a^2 + b^2 = c^2$

The Pythagoras theorem has multifaceted uses, which the Pythagoreans perfected. The precision of Greek architecture has been mentioned before, so it is no surprise that the Pythagoras theorem is used even today by architects and engineers. Here too one finds Apollo, who alongside Poseidon built the impregnable walls of Troy. The Pythagoreans who grew up listening to the myth of Troy saw in those walls the mathematical tricks of building strong structures, and Apollo as the builder only reinforced their faith in the god as the greatest mathematician. As the myth goes, Apollo also predicted that the wall will only fall on the third attempt, as would the city of Troy. A prediction of this sort can be made by a modern engineer as well, thanks to numerical equations. Plato is believed to have heavily derived from Pythagoras' study of mathematical principles, and used it to derive logic and reasoning in his own works.

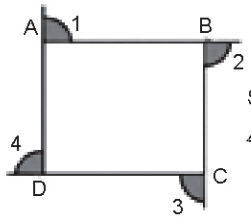


Geometry provided architects with the tools necessary for proper design and construction (Leonardis, 2016). The temple construction was based on the use of such ratios as 2:3 and 4:9. Moving from more minor parts to more significant amounts was the fundamental strategy based on the essence of symmetry. This design led to the construction of buildings characterised by such concepts as symmetry and harmony.[4]

Pythagoreans did not remain confined to right angled triangles. They discovered that the "sum of all angles of a triangle is equal to two right angles" and that "polygon with n sides is equal to (2n-4) right angles and the sum of its exterior angles is equal to four right angles….They were also able to compute the solution of equations like $a(a-x)= x^2$ with the help of geometry." Such calculations are called geometric solutions for algebraic equations, and they are based heavily on the Pythagoras theorem.

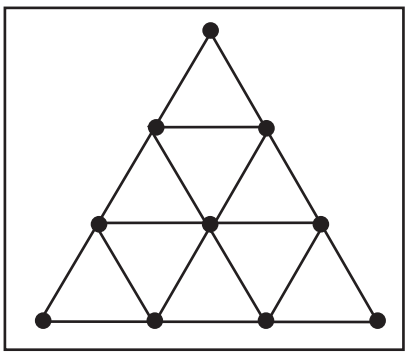


Sum of the external angles = 360°
∠1 + ∠2 + ∠3 = 360°

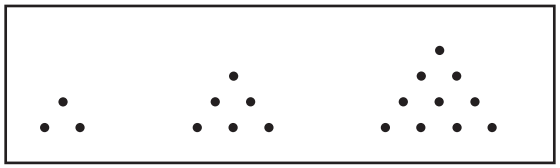


Sum of the external angles = 360°
∠1 + ∠2 + ∠3 + ∠4 = 360°

They also pondered over the geometry of Tectactys: representing the number 10. It closely tied to the representation of numbers via dots. The Tectactys is perfect in their opinion because it represents: (a) the four cardinal elements: fire, water, earth, and air; (b) the three big gods; c) the two genders; and (d) the unity of the Universe.

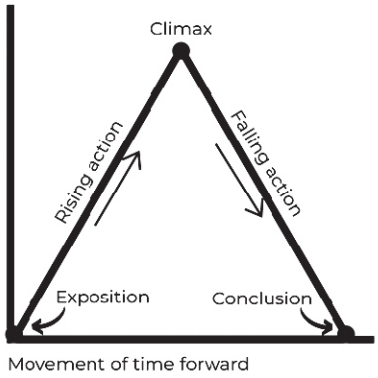


As Grayling writes: "Pythagoreans thought that ten is the natural basis of counting, and gave it a mystical significance. There is of course an infinity of 'triangular numbers' – three is represented as the triangle of two dots with one dot above it; six is represented as a triangle of dots arranged '3–2–1'; ten we have seen, fifteen is '5–4–3–2–1', and so on."



The triangles are also the easiest to emulate in art and architecture. While nature mostly uses the circle, like the leaf, the structure of the human face, and so on, architecture uses straight lines. The pyramids are a great example of the usage of triangles to attempt to reach the heavens. The Classical Greeks used triangular friezes on top of the rectangular temples: a structure very commonly seen all across Greece. The round pillars set in contrast to the polygonal structure of the temple gave them a sense of life. Temples and adjoining structures were also often placed in a triangular layout (see Acropolis layout above). The mountain itself is a triangle, and Mount Olympus being the abode of the gods echoed the Egyptians' attempt to reach divinity via triangles. Very few shapes exhibit as much mathematical versatility as a triangle.

The structure of a play also follows a triangle: it starts at the bottom with exposition, followed by the steep upward slope of rising action, reaching the pinnacle in the climax, then moving down in the falling action, ending in a conclusion. This structure was strictly followed by Ancient Greek playwrights.



The divinely inspired stories as well as the mythical themes of these plays used this triangular path to emulate the divine, and even later works like those of Shakespeare and Webster follow this method. Commercial cinema too uses this chart to captivate the audience. Needless to say, the triangular movement of the plot through time is the best time tested method to create a story. Pythagoreans, who enjoyed the art of poetry and drama, saw in the triangular structure the figure of Apollo, the consort of the Muses, and the divine god of these arts. Currently, the Apollo Theatre remains one of the most popular spots for lovers of drama.

Aristotle is an especially important name in this regard: his *Poetics* sets the base rules of literature that have at once been strictly followed and grossly flouted to create impressive tales of human imagination. The Aristotelian principle is simply the product of mathematical patterns juxtaposed on the abstraction of literature and myth. While painting requires the support of materials to bring out artistic perfection,

[5] Grayling; *History of Philosophy*

literature can use words. To place the words perfectly and create ideas that can remain timeless, the Ancient Greeks established the role of mathematics in art beyond a single reasonable doubt.

Conclusion

It is rather easy to dismiss Pythagoreanism as a cult that coincidentally got things right. They faced quite some barriers in their studies. For instance, they are attributed with discovering irrational numbers, but the experience stumped them so much that the one man who revealed this finding to the other members was punished by being drowned to death. Some scholars believe that the irrational numbers caused Mesopotamians to give up studying the Pythagoras theorem. The Pythagoreans used a simple explanation: if the horizontal side is 1 inch (or 1 metre, yard, and so on), then the diagonal would be the root of 2. But the root of 2 is not a whole number, and neither is it the familiar fractional number. This shocked them, yet, they recorded the discovery and today irrational numbers are as indispensable as rational numbers. And it's known that the rule applied to musical strings does not adhere to planetary positions. But to reach these conclusions, as well as make impressive progress with the aid of math, the contributions of the Pythagoreans must be admitted. Their understanding of the universe can be simply assimilated in one figure: Apollo. And when one sees the connections that thread together the god's powers, one can see the dedication and precision of the people who worshipped him.

Mankind's progress has often been set back by socio-political factors. The loss of Pythagoras' works and those written under him is a grave blow to our progress that is worth acknowledging. A mathematician who undertakes the difficult task of finding the meaning of the universe must start with Pythagoras and his school. Because this is where our collective journey as a species to find reason against the vast cosmic background began and took a prolific shape. It set the stage upon which our society stands today.

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Interdisciplinary Insights between Economics and Mathematics : Perspective at Secondary Level Education in Kolkata

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Abstract:

The varied disciplinary domains existent in the academic sphere have distinct ways of thinking and reasoning. In contrast to the social sciences, which mostly rely on observation, sciences primarily rely on experimental verification of the various sorts of study conducted. Mathematics and Economics are two crucial subjects that exist in both the social sciences and the sciences, and in accordance with their existence is the impending appearance of their coexistence, which will highlight the interdisciplinary approach of various disciplines. The subject of Mathematical Economics highlights this coexistence. The creation of economic ideas and models requires the use of mathematics. It may be used to replace words with mathematical symbols and sentences with equations. It is a strong tool for logic and reasoning. This makes it possible to use economic theories and models in a way that is more exact and useful. In the presented research explores and analyses the level and intensity of knowledge and awareness existent in the teachers and students at the secondary level of school education in Kolkata. In most cases, the teachers, and students have shown a high level of understanding with regard to the inter-relationship between economics and mathematics in certain chapters common to both. There was a significant knowledge gap persistent in the teachers with the understanding of the inter-disciplinary nature of economics and mathematics in certain specified topics. Comprehension of the concern and further comprehension yielded that the same persisted in case of students too.

Keywords : Economics, Education, Interdisciplinary, Mathematics, Secondary Level, School

Introduction

The era of 19th century witnessed people treating various fields of study, such as mathematics, sciences, social sciences, and languages, in their own individual encases, and they began restricting their specialization in one specific domain without much consideration for how that field relates to any of the other disciplines. The academic world began to follow a trend of diversifying into ever-more narrower fields, where rivalry among them was even promoted as a natural stimulant to quicken the rate at which each subject developed. Unbeknownst to them, this branching out was isolating them through ever-narrower arteries even though it facilitated some economic gains through job advancements and

the marketability of expertise. As a result of the congestion in these arteries, this trend can be noticed even within a certain discipline. The feeling of crowding is brought on by rivalry. Because there is a market for information, competition grows. All the economic elements affecting the person or group are thus under the authority of the market. This is among the causes for the concern about the "mathematization of economics" even becoming a conversation point.

Researchers in one subject unintentionally became insensitive to the repercussions of their actions on any of the other disciplines due to the forced separation of different branches of knowledge for a century. Since the experts themselves were trying to evaluate things with their tunnel vision, it was difficult to even determine what went wrong and why when things with some of the policies established in some countries during this period went awry. Toward the close of the 20th century, the trend of isolation and segregation began to shift, and the terms "inter/multidisciplinary" research began to take on special significance.

For a number of reasons, including its capacity to simplify understanding of economic concepts, articles, prepositions, and other issues, mathematics can be applied to economics. Additionally, the subject's applicability can make it seem more approachable. Furthermore, since the mathematics in the topic is founded on logic, its application can encourage logical thought, assisting in the general growth of a person's inductive, rational, and logical thinking.

The use of mathematical methods to analyze economic problems and explain economic theories is known as mathematical economics. Economists may create theoretical relationships with correctness, uniformity, and simplicity thanks to mathematics. Additionally, it makes it possible for economists to create insightful, useful hypotheses regarding extensive and complex subjects that would otherwise be challenging to express in colloquial language. In addition, the use of mathematical terminology allows economists to make specific, conclusive claims about contentious or contentious themes, which is not feasible without the use of mathematics. At present, a lot of economic theory is given as stylized and sped-up mathematical relationships and economic models to clarify assumptions and implications.

Literature Review

Table 1: Summary of Literature reviewed

Author(s)	Title	Inference
Sun, Y. (2022)	"Applications of Advanced Mathematics in The Field of Economics"	Numerous disciplines, especially economics, frequently employ mathematics. For economic research to be successful, a connection between mathematics and economics is necessary. This research uses a literature review methodology to investigate the connection between advanced mathematics and economics and how it might be used to solve economic issues. Using case studies, it is concluded that the only way to efficiently resolve economic challenges is by choosing the appropriate mathematical procedures for the various economic issues.

Author(s)	Title	Inference
Salunkhe, A. S. (2020)	"Applications of Mathematics in Economics - A Study"	The objective of this paper was to investigate fundamental mathematical tools that are widely used in all areas of economics, such as microeconomic, macroeconomic, and econometric. It was concluded that, without the utilization of mathematics, economic concepts are incomplete. In order to comprehend economics, mathematics must be employed in each point. By utilizing mathematical techniques, economic concepts are understood in a manner that encourages the development of interest in the subject.
Zakirova, V. G., & Shilova, Z. V. (2016)	"Integrative Connection of Mathematics and Economics"	In order to integrate intersubject connections, the goal of this article is to develop and demonstrate a model of integration between general and specific economic disciplines and mathematics. It also proposes an algorithm for choosing the most pertinent variables during the specification phase of building an econometric model. The main method used to study this subject is the use of mathematical tools and models to the development of prospective economists'; professional competencies, which in turn results in the development of their fundamental economic knowledge and skills.
Dow, S. C. (206)	"The Use of Mathematics in Economics"	This article explores the development of conceptual and methodological aspects of contemporary economic theory as well as the history of mathematical tools in economics. In the article, different examples of mathematical modelling are given, together with theoretical and procedural considerations resulting from research in economics and mathematics.

RESEARCH METHODOLOGY

➢ IDENTIFICATION OF THE PROBLEM

Numerous disciplines, especially economics, often involve mathematics. In order to assure its applicability, it is crucial to connect economics to mathematics. The issues and study in the subject of

economics must also be backed by mathematics. The use of mathematics in economics is crucial for the advancement in science and technology. Standalone education sphere, in relation to mathematics, may not be considered scientifically valid.

There have been several researches based on the use of mathematics in economics, but almost all of them are based on higher education facet. They involve use of advanced mathematics in advanced domains of economics studies.

Given the context, reviewed literature highlights a gap in research in the concerned domain – in the higher secondary education sphere. Thus, the presented research is an attempt to bridge the gap present in the academic sphere to enable critical analysis of the interdisciplinary nature of economics and mathematics, specifically at the higher secondary level of education.

➢ OBJECTIVES

1. To assess the knowledge of teachers teaching in higher secondary level of school education regarding the interdisciplinary nature of economics and mathematics.
2. To evaluate the understanding of students at higher secondary level of school education on the application of Mathematics in Economic concepts.
3. To analyse the knowledge differences between teachers and students at higher secondary level of school education about the varied use of Mathematical tools in the domain of Economics.

➢ METHODOLOGY DESIGN

- The study is conducted in one-point time frame in 2023.
- The analysis is based on primary data through a well-structured questionnaire.

Sample Design:

The presented research is based on Convenience Sampling Method along with Purposive Sampling Method.

Students of Secondary Classes (Class XI and XII) – 100

Teachers teaching Secondary Classes (Class XI and XII) – 100

- Tools and Techniques used for Analysis:

  Graphical Representation

  Representation analysis through percentage-based technique

  Inferential Statistics: Chi-Square Testing

BACKGROUND OF MATHEMATICS TOOLS AND RELATED APPLICATION IN ECONOMICS CONCEPTS

Table 2: Interdisciplinary Connections between Economics and Mathematics

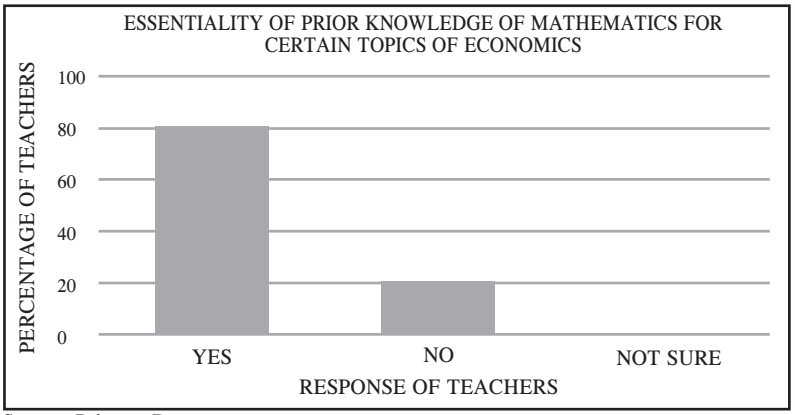
MATHEMATICAL TOOLS	APPLICATION IN ECONOMICS
(i) Functions	(a) Demand Function (b) Supply Function (c) Production Function

MATHEMATICAL TOOLS	APPLICATION IN ECONOMICS
	(d) Consumption Function (e) Savings Function
(ii) System of linear equations	(a) Demand and Supply (b) Cost and Revenue (c) Production Problems (d) Consumption and Savings
(iii) Straight Lines	(a) Demand and Supply (b) Money Market (Equilibrium) (c) Price Elasticity of Demand (d) Break-even Analysis (e) Budget and Cost Constraints (f) Consumption and Income (g) Profit Maximisation
(iv) Quadratic Functions and Equations	(a) Demand and Supply (b) Various Cost Analysis (c) Cost and Revenue Analysis (d) Total Revenue and Profit Function
(v) Differential and integral calculus	(a) Marginality Analysis (b) Elasticity (c) Consumer surplus and producer surplus
(vi) Maxima and Minima	(a) Cost Minimisation (b) Revenue and Profit Maximisation (c) Consumer Price Index (d) Wholesale Price Index
(vii) Statistics	(a) Production, distribution, and consumption problems (b) Pricing Strategies in different market structures (c) Economic Problems like Income and Employment (d) Fiscal Policy (e) Budgeting
(vii) Arithmetic	(a) National Income and Circular Flow (b) National Income Aggregates (c) Measuring National Income (d) Consumer Price Index (e) Wholesale Price Index

ANALYSIS AND FINDINGS

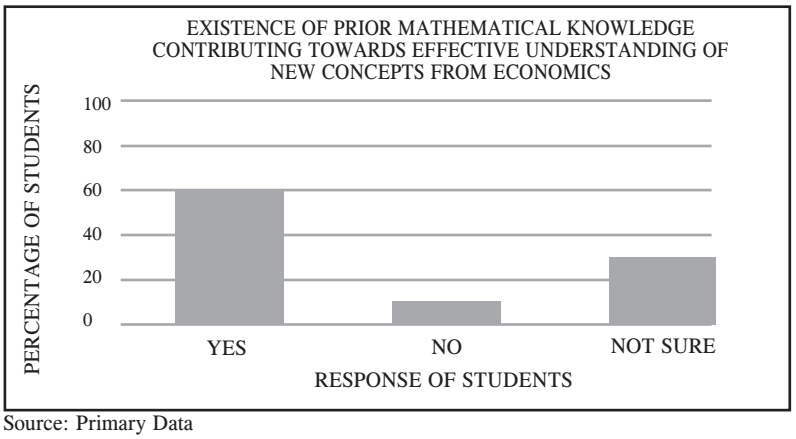
➢ SET 1: PRIOR KNOWLEDGE OF MATHEMATICS TO UNDERSTAND CONCEPTS FROM ECONOMICS

Chart 1: Graphical Representation of the responses of teachers



Source: Primary Data

Chart 2: Graphical Representation of the responses of students



Source: Primary Data

While 80% of the teachers constituting the sample agree on the essentiality of prior knowledge of mathematics for certain topics of economics, only about 60% respond concretely in favor of the same. Possible reasons, for a lower count in student's aspects, could be their inability to comprehend the connect and link between some mathematical concepts with concepts from economics; time driven aspects wherein there exist time lag between knowing and understanding related concepts and topics from mathematics, statistics, and economics.

To understand the relatedness, it is possible and correct to state that more than 50% of the sample population, in both cases – teachers and students – agree that prior knowledge of mathematical and statistically concept does exert a favorable influence while both – teaching and learning/understanding concepts from economics.

Table 3: P-Value analysis through Chi-Square Testing

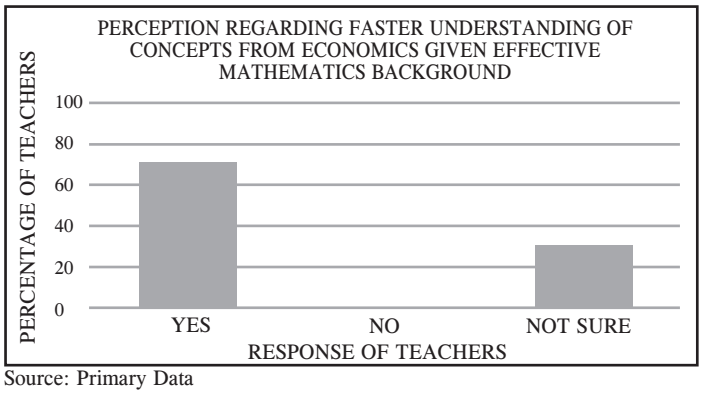
	36.19047619
df	2
p-value	0.0000000138464
	0.05

Source: Author's Computation

p-value Essentiality of prior knowledge of mathematics to understand concepts from economics in context of both teachers and students. The above testing yields the significance of the prior knowledge of mathematics to understand new and specific concepts from the domain of economics.

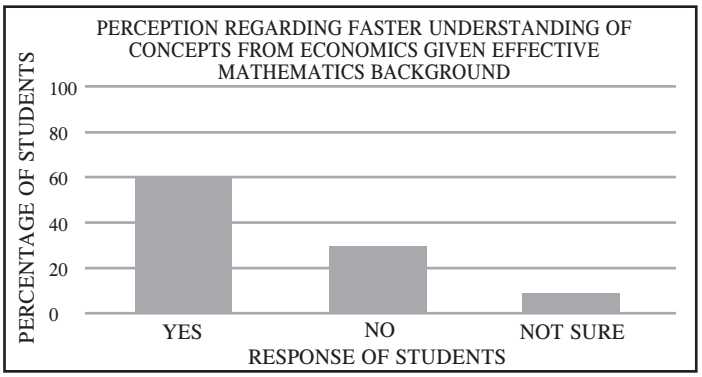
➢ SET 2: EFFECTIVE MATHEMATICS BACKGROUND UNDERSTAND CONCEPTS FROM ECONOMICS FASTER

Chart 3: Graphical Representation of the responses of teachers



Source: Primary Data

Chart 4: Graphical Representation of the responses of students



Source: Primary Data

Responses to this question revealed that an absolute of 70% teachers constituting the sample agreed in complete context that students with effective mathematics background understand economics concepts faster. Additionally, 30% teachers were not able to clarify the same with surety. There are many ways in which mathematics in economics can be used. Successful and effective learning occurs when students are able to master economic concepts and mathematics at the same time. On the front of students, 60%

of the sample constituted faster understanding of economics given prior effective knowledge of mathematics. 30% of the sample outright rejects and showcases lack of any correlation between the two concerned domains. 10% of the students are 'Not Sure' of the given context.

Table 4: P-Value analysis through Chi-Square Testing

	40.76923077
df	2
p-value	0.00000000140305
	0.05

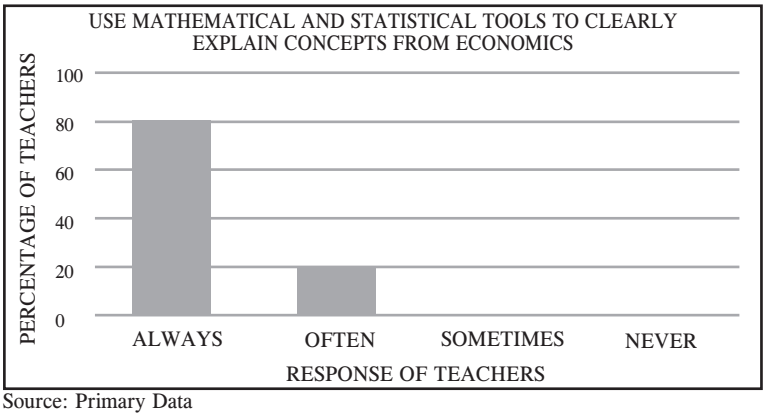
Source: Author's Computation

p-value Knowledge of mathematics contributes to faster understanding of concepts of economics by both teachers and students.

The above testing yields the significance of the prior good and effective knowledge of mathematics which largely contributes to faster understanding of concepts of economics by both teachers and students.

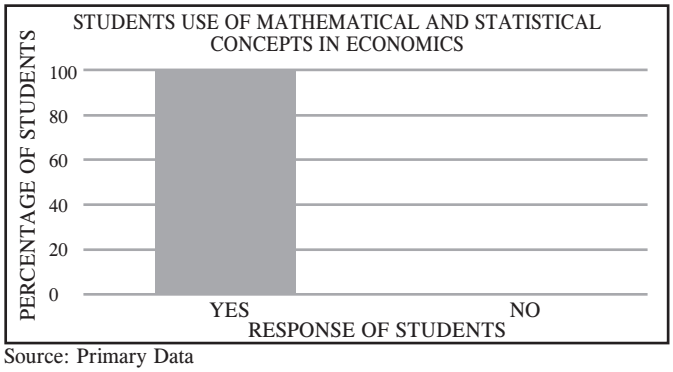
➢ SET 3: USE OF MATHEMATICAL AND STATISTICAL TOOLS IN ECONOMICS

Chart 5: Graphical Representation of the responses of teachers



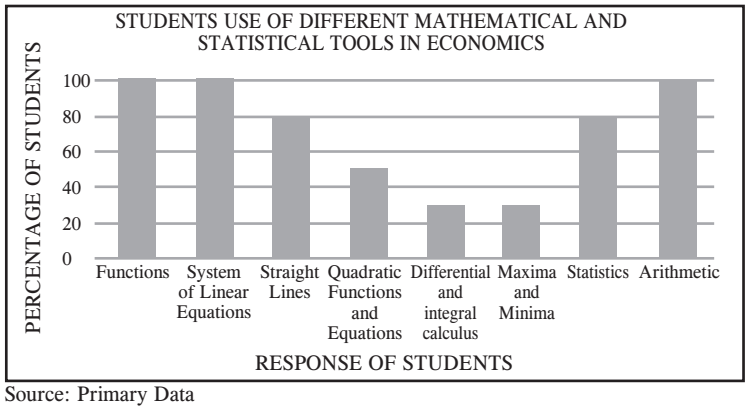
Source: Primary Data

Chart 6: Graphical Representation of the responses of students



Source: Primary Data

Chart 7: Graphical Representation of the responses of students



Source: Primary Data

According to the survey, 80% of the teachers teaching at higher secondary level of school education respond to be making use of mathematical and statistical tools to effectively teach economics to students. They state mathematics makes it easier for them to handle concepts, theories, and sum; and clearly explain the same. On a positive front, 100% of the students reveal to be making use of mathematical and statistical tools to understand economics better. Each student responds to using some or the other mathematical and statistical tool - Functions, System of linear equations, Arithmetic, Straight Lines, Statistics, Quadratic Functions and Equations, Differential and integral calculus and Maxima and Minima - to obtain an effective understanding of economics.

Hence, it can be well-established that there exists a connect between the responses of students and teachers, whereby teachers make use of mathematics and statistics to teach concepts from economics better and effectively; and students use the same to learn and built a grasp on the economics discipline via the use of mathematics discipline.

Table 5: P-Value analysis through Chi-Square Testing

	22.22222222
df	1
p-value	0.00000242846748
	0.05

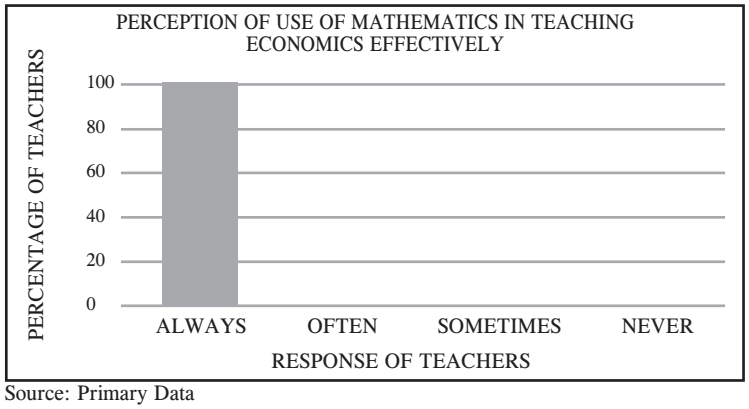
Source: Author's Computation

p-value Significant use of mathematical and statistical tools in economics by both teachers and students.

The above testing yields the significance of the use of the mathematical and statistical tools to clearly explain the concepts of economics by teachers, and to understand the concept of economics in a better front by the students.

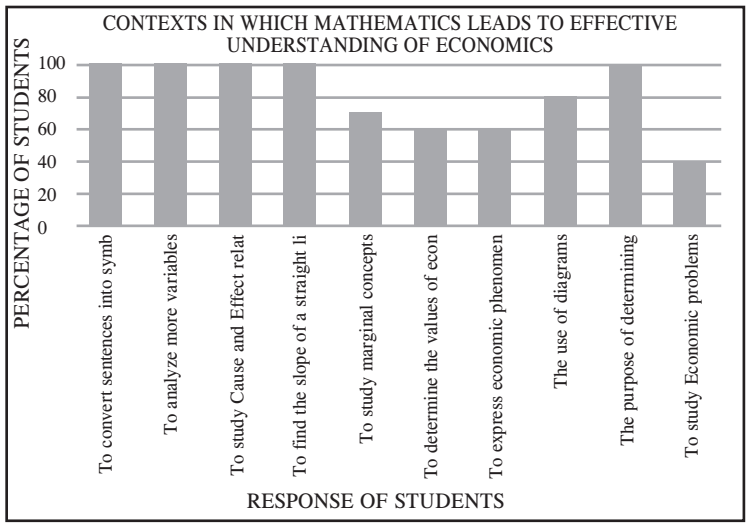
➢ SET 4: PERCEPTION OF INTERRELATIONSHIP BETWEEN MATHEMATICS AND ECONOMICS

Chart 8: Graphical Representation of the responses of teachers



Source: Primary Data

Chart 9: Graphical Representation of the responses of students



Source: Primary Data

100% teachers teaching at higher secondary level of school education find it easy to each economics better with the use of mathematics. On the students front, more than 50% of the students responded to be making use of mathematical concepts.

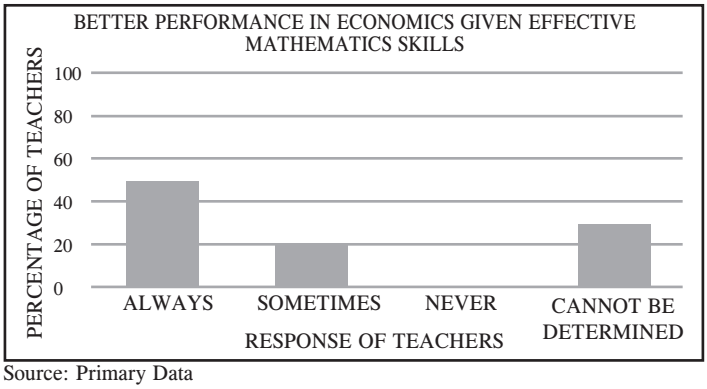
As responses, it was stated that mathematics helps in teaching and learning economics better given the following pointers:

- To convert sentences into symbols
- To analyze more variables
- To study cause and effect relationship
- To find the slope of a straight line
- To study marginal concepts
- To determine the values of economic variables
- To express economic phenomena algebraically

- The use of diagrams
- For the purpose of determining economic policies
- To study economic problems

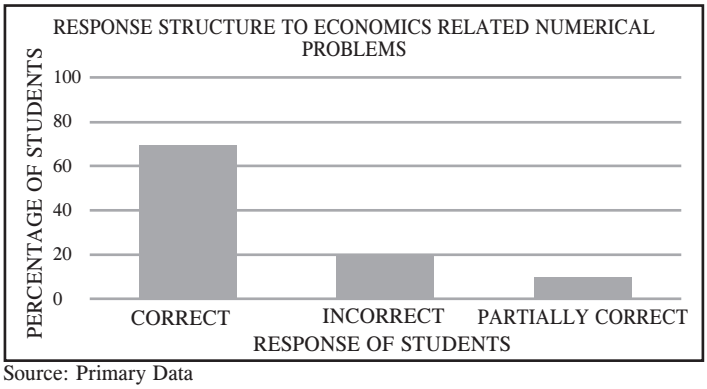
➢ SET 5: PERFORMANCE IN ECONOMICS GIVEN EFFECTIVE MATHEMATICAL UNDERSTANDING

Chart 10: Graphical Representation of the responses of teachers



Source: Primary Data

Chart 11: Graphical Representation of the responses of students



Source: Primary Data

While 50% of the teachers completely bring forward that students with effective mathematics grasp perform better in economics, 20% think the same is true but 'Sometimes'. Further, 30% of the teachers surveyed extended responses which suggest that they cannot concretely relate to students good/ not good performance in economics with that of mathematics.

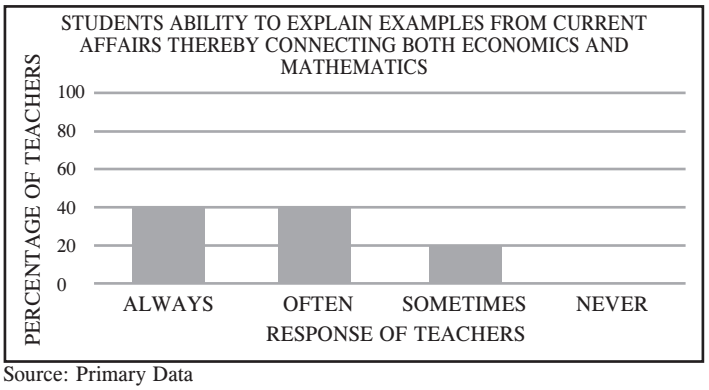
From student's responses as solutions to the sums, it was obtained that –

- In some cases, knowing of economics driven concept was insufficient to solve the sum correctly, and it was lack of mathematically knowledge that created a major concern.
- In some cases, knowing of mathematics and statistics driven concept was insufficient to solve the sum correctly, and it was lack of economics related knowledge that created a major concern.

Thus, it can be well established, via the presented sum, that good hold on both mathematics and economics is crucial to correctly solve the sum in context.

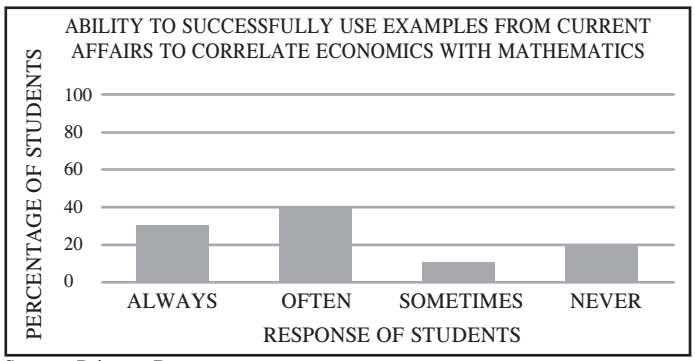
➢ SET 6: ABILITY TO EXPLAIN CURRENT AFFAIRS BY DEPLOYING BOTH ECONOMICS AND MATHEMATICAL KNOWLEDGE

Chart 12: Graphical Representation of the responses of teachers



Source: Primary Data

Chart 13: Graphical Representation of the responses of students



Source: Primary Data

According to the survey - 40% of the teachers constituting the sample extend responses which show that their students can from 'Always' to 'Often' are able to explain examples from current affairs connecting both economics and mathematics; 30% of the students constituting the sample extend responses which show that they are 'Always' successfully, able to explain examples from current affairs connecting both economics and mathematics. A slightly greater number leading to 40%, are able to 'Often' do the same.

It is clearly visible and comprehendible that teacher's notion of his/her student's ability to link examples from current affairs directly with economics, is in line with student's self- governing perception and outlook regarding the same.

Table 6: P-Value analysis through Chi-Square Testing

	24.76190476
df	3
p-value	0.0000173155
	0.05

Source: Author's Computation

p-value Considerable ability to explain current affairs by deploying both economics and mathematical knowledge by both teachers and students.

The above testing yields the significance of mathematical understanding by both teachers and students to explain current affairs from the context and concepts of economics.

FINDINGS

1. A good number of teachers (80%) forming a part of this study think prior knowledge of mathematics is essential for certain topics of economics.
2. Many teachers clearly state that they make use of mathematical and statistical tools to clearly explain concepts from economics.
3. An absolute of 70% teachers constituting the sample agreed in complete context that students with effective mathematics background understand economics concepts faster.

   On the students front, the same was constituted by 60% of the directed sample.
4. While 50% of the teachers completely bring forward that students with effective mathematics grasp perform better in economics, 20% think the same is true but 'Sometimes'. Further, 30% of the teachers surveyed extended responses which suggest that they cannot concretely relate to students good/ not good performance in economics with that of mathematics.
5. Only 40% of the teachers constituting the sample extend responses which show that their students can from 'Always' to 'Often' are able to explain examples from current affairs connecting both economics and mathematics. The number is on a lower end.
6. 100% students agreed to be putting to use mathematical and statistical concepts in economics.
7. Each student responds to using some or the other mathematical and statistical tool - Functions, System of linear equations, Arithmetic, Straight Lines, Statistics, Quadratic Functions and Equations, Differential and integral calculus and Maxima and Minima - to obtain an effective understanding of economics.
8. 100% students respond to agreeing that all concepts of economics make by and large use of some or the other mathematical and statistical tools.
9. In exact of 100% students revealed the mathematics and statistics helps them in understanding economics better in varied ways.
10. With ever changing, dynamic environment, including the education arena, it becomes substantially important for students to develop a holistic view about anything and everything, especially in educational front. Along the same lines, comes into view the need to be up-to-date with the happening in the surrounding at a global level and hold the ability to bring in down concisely and concretely to what is being taught and learnt in as a part of educational intake. A good percentage, i.e., 70% students are almost driving towards a positive approach in the directed context, but the number still needs to be on a larger side.

11. P-value analysis through Chi-Square testing yielded the below:
    - There exists significant essentiality of prior knowledge of mathematics to understand concepts from economics in context of both teachers and students.
    - There exists significance of the prior good and effective knowledge of mathematics which largely contributes to faster understanding of concepts of economics by both teachers and students.
    - There exists significant use of mathematical and statistical tools in economics by both teachers and students.
    - There exists considerable ability to explain current affairs by deploying both economics and mathematical knowledge by both teachers and students.

EDUCATIONAL IMPLICATIONS

1. It is forthwith given credence that using a mathematical approach when teaching the principles of economics course is effective at conveying economic content. Even though many students lack basic mathematical skills, it seems possible that using basic math in teaching and problem-solving exercises could improve students'; understanding of economics.
2. When applied appropriately in economics, mathematics serves as a tool for cognition and a means of quickly achieving objectives without having to become an objective in and of itself. It is obvious that it will be challenging to have a solid understanding of economics without a solid foundation in mathematical ideas. This demonstrates how mathematics and economics coexist and how a solid understanding of mathematics is necessary to spark a keen interest in economics and makes the topic easier to comprehend.
3. The attitude and proficiency of students in mathematical disciplines directly influence their knowledge in economic subjects, and intersubjective links between these disciplines are both objectively possible and recommended. The study of economic discipline tends to find greater depth and applicability for the knowledge acquired via the study of mathematics.
4. There are strong intersubjective ties between mathematics and economics. With the aid of mathematical techniques based on both theoretical mathematical principles and the widespread usage of computers, mathematics aids economics in its ability to solve and analyse extremely complex economic problems, and eventually, clarifies the economic significance of the results achieved. Through logically sound economic foundations as well as mathematically concrete installations, it aids in strengthening the overall input-output process. This in turn encourages participation by learners in the interdisciplinarity of various subjects.
5. It is not a coincidence that mathematics is used to teach varied concepts in economics. Since the personal and contextual factors that affect how mathematics is used, have been isolated and defined, using mathematics at higher secondary level of economics education is a reasonable decision. This additionally offers a fundamental justification for using mathematics as a teaching and performance evaluation tool in the classroom, with regard to quality teaching and learning of the economics domain.

CONCLUSION

Economics and mathematics are two separate but related academic disciplines. Mathematics is a language of numbers and numerical symbols that may be used to convey ideas like size, amount, and more precisely. Contrarily, the study of economics focuses on how resources are distributed and how decisions are made on the distribution of products and services. Most areas of modern economics heavily rely on arithmetic and statistics.

Mathematics is necessary to support the logical processes that are used to solve complex economic problems. It is used to study past economic interactions as well as to quantify or give measure and significance to economic notions. It is also used to simulate the potential results of suggested scenarios, giving economists an understanding of what would happen to the economy if measures were done. Without the use of mathematics, two of the best methods for mimicking real-world settings are economic analysis and modelling. Numerous mathematical techniques, including geometry, calculus, and linear algebra, can be used in the study of economics.

In order to quantify economic phenomena in conjunction with economic theories, math and statistics are utilized in economics. Since then, they have emerged as the most important tool for forming global economic policy. Mathematical economics, forecasting, and market analysis are other fields of economics that heavily rely on mathematics to enhance their theories and applications.

Most economists concur that the use of mathematics and statistics, when done correctly and for the intended purpose, is both necessary and advantageous. Regardless of whether they are categorized as physical or social, a large range of fields use mathematics in this way, not just economics. In general, the physical science disciplines prefer to welcome the application of mathematics with open arms, as if it were a beloved family member returning to help in a time of need.

Finally, it can be clearly seen and stated that the use of mathematics in economics is, to a certain extent, both inevitable and necessary in order to formulate effective policies, carry out effective planning, take a variety of decision-making stances, lay concrete foundations for theory formulation and extension, and ultimately obtain optimal solutions and favourable results from both a long-term and short-term perspective.

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Environment and a Mid-term Evaluation of Seventeen UN Sustainable Development Goals – An Approach

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Abstract:

There are numerous, multi-disciplinary definitions of the term "environment." It is crucial to understand that the environment primarily refers to our natural surroundings and how we interact with them. Let's investigate a few of these methods. A geologist establishes the history of the earth in terms of numerous natural events like magmatism, volcanism, earthquakes, and metallogenies, essentially in terms of time and space. A biologist is more concerned with ecological issues; a chemist is more interested in pollution and pollutants; a geographer searches for physiographic features such as mountains, oceans, rivers, deserts, and soils and their effects on the socioeconomic structure of human settlements. In contrast, a physicist keeps track of the energy, motion, gravitation, atmosphere, and other relevant factors. It is significant to note that all of these theories strongly imply that particular causative factors govern every single natural event. The scientists firmly believe that geography controls the occurrence or identification of any event. The current global environmental crisis brought on by climate change is overwhelmingly present in all regions of the world. We find cyclones, bushfires, ice melting, carbon emissions, and other things. Even at the most recent G20 summit, world leaders vowed to eliminate carbon emissions by the year 2050, with a special emphasis on the development of recyclable electricity, environmentally friendly hydrogen fuel, and the creation of the Global Biofuel Alliance. They conceded that by 2030, there will need to be a provision of 5.8 to 5.9 trillion US dollars to balance the "Loss and Damage Fund." In this paper, an attempt has been made to evaluate mid-term progress of 17 UN Sustainable Development Goals(SDGs) with reference to environment.

Keywords : Climate Change, Environment, G20 Summit, Nature, SDGs.

Introduction :

At this crossroad, let us briefly recapitulate the 17 UN Sustainable Goals (Figure1), adopted in September 2015 by the World Leaders and to be achieved by 2030. These are - SDG 1: No Poverty; SDG 2 : Zero Hunger; SDG 3: Good Health and Well Being; SDG 4: Quality Education; SDG 5: Gender

Equality; SDG 6: Clean Water and Sanitation; SDG 7: Affordable and Clean Energy; SDG 8: Decent Work and Economic Growth; SDG 9 : Industry, Innovation and Infrastructure; SDG10 : Reduced Inequalities; SDG 11: Sustainable Cities and Communities; SDG 12 : Responsible Consumption and Production; SDG 13 : Climate Action; SDG 14 : Life Below Water; SDG 15: Life on Land; SDG 16 : Peace, Justice and Strong Institution; SDG 17: Partnerships for the Goals.

FIGURE 1: 17 UN Sustainable Development Goals.

A close look at the 17 UN Sustainable Development Goals and overall, 169 targets points toward **capacity building**, **efficiency**, **mitigation, recycling**, **reduce, resilience, vulnerable,** etc. This clearly reflects that whatever goal we choose, whatever target we want to attain, intermingling of SDGs and the all-inclusive approach in terms of synergies and trade-offs can lead us to achieve the 17 SDGs.

The usage of some of the words above (in bold) can be understood if we look at some of the targets. By 2030, increase the resilience of the poor and those who are vulnerable, as well as lessen their exposure to and vulnerability to other economic, social, and environmental shocks and disasters. This is stated in the target 1.5.

By comprehending the synergies and trade-offs of the SDGs, it will be possible to evaluate man and the environment through the transformation mechanism that follows the 2030 agenda of Sustainable Development Goals. The key word for Sustainability issues under the overarching theme of Governance should be transformation. In order to better understand the potential pathways of sustainable environmental issues, it shows the intriguing energy within the global sustainability discourse in moving from "describing problems" to "identifying solutions." Every time the 169 targets under the umbrella of the 17 SDGs are explored, the people are informed of all the goals and the true meaning of the words used above.

One point needs to be emphasized here. Younger generations should receive training in SDG 3 (Good Health and Well-Being), SDG 4 (Quality Education), SDG 5 (Gender Equality), and SDG 10 (Reduced Inequalities) while concentrating on SDG 5. The SDGs 3, 4, and 10 are arranged in a quadrangle, which gives young adults motivation to work toward the SDGs. However, it is undeniable that the interlinking of the 17 SDGs is the best way to achieve governance, and even the aforementioned phrase (abuse to yield) provides us with the motivation we need to advance in the direction of transformation.

Research Design Analysis :

It is emphasized that whatever discussion and results that will be presented here, are absolutely considered to be secondary data. The author would try to analyse those information from different aspects.

We see the interrelationship from some other angles, especially Environmental Sustainability. Steve Cohen of Earth Institute, Columbia University, in his short article, "Beyond Climate: The Crisis of Environmental Sustainability', wrote, "Climate change, toxic contamination of the land, ecosystem destruction, air pollution and water pollution are all forms of environmental degradation that we need to learn more about and act to reduce. Each is important. Environmental Sustainability requires that we stop global warming, but we must move beyond climate change and address the other critical challenges confronting the planet". We must believe in the fact that **there is no *Planet B***.

At the halfway point toward our goal of achieving the SDGs by 2030, various assessments are being made regarding the fulfilment of the SDG commitments. In order to find a more meaningful connection between the environment and the SDGs, it is crucial to have ideas about those. To begin with, it's crucial to become familiar with some of the jargon that scientists and decision-makers use to describe the phenomenon of global climate change. Since most of the terms are self-explanatory, they are not strictly defined here. The terms are: Anthropogenic climate change, just transition, Climate intersectionality, Regenerative agriculture, Common but differentiated responsibilities, Nature based solutions, Net zero emissions, decarbonisation, Heat action plan, Wet bulb temperature, Distributed renewable energy, Loss and damage, Circular economy, Environmental, social and corporate governance.

Sources Explored and Corresponding Analysis :

According to the Millennial Manifesto and ORF's online reporting, the world community is dealing with issues like poverty, migration, and climate change, and young people should be actively involved in finding solutions. According to the UN, youth participation as innovative individuals and critical thought leaders is essential to achieving the SDGs. The SDG is currently halfway to achieving its goal of being completed by 2030. At this stage, the youths should focus on certain aspects, such as **Building Resilience against multi-dimensional vulnerabilities, undertaking cross-border youth**

cooperation, prioritising maternal healthcare (*According to Bill and Melinda Gates Foundation Seventh Annual GOALKEEPERS REPORT, September, 2023, it is said, "Across the world, nearly 800 women die in childbirth every day. An estimated 74% of child's death s happen during a baby's first year.' The foundation is of the opinion that by scaling up the process of global access to innovatory practices, we can address the most essential causes of maternal and new-born deaths.).* These include supplying sufficient child care, combating infectious disease, Creating competent and sympathetic teachers, putting an end to all forms of violence against women and girls, recognizing and appreciating unpaid domestic and care work, implementing inclusive and fair labour practices, Taking part in activism, sensitization campaigns, and advocacy taking part in international solidarity initiatives and policymaking processes, supporting green technologies, environmentally friendly consumer choices, and other Sustainable Development Goals (SDGs)-related initiatives.

It is clear from reading Mannat Jaspal's ORF online reporting on India's G20 Leadership: Elevating Capacity Building for Sustainable Development Financing that the main goal is to increase efforts to direct sizable global capital pools for sustainable projects, primarily to be implemented in emerging and developing countries. The G20 group has further stated that it will work to create the first Technical Assistance Action Plan (TAAP), which will result in an eco-system of capacity-building initiatives encompassing a number of advisory, operational, and technical programs, under the auspices of the Sustainable Finance Working Group (SFWG). According to the UN, the financial gap will reach US$ 17.9 trillion by the end of the 2020–2025 period as a result of COVID and the Russia–Ukraine war. The report outlines the types of capacity constraints, including knowledge gaps, elevated risk aversion, a lack of regulatory capacity, weak domestic capital markets, and investments that favour the environment at the expense of other SDGs. A "sustainable" New Delhi Declaration: G20's Acceleration on DG was the title of another online ORF report by Soumya Bhowmick. It was noted that the report advocated "Acknowledging the transformative role of digital technologies, artificial intelligence (AI), and data advancement in advancing the DG, the G20 lend it support to the G20 Principle of Harnessing Data for Development (D4D)."

The Stockholm Environment Institute (EI) launched a campaign for the global leader, thinker, and decision-maker in general before the SDG summit. The phrase "Time to Lead- science to accelerate Global Goal" was coined by EI Researcher. They placed a strong emphasis on collective intelligence, setting a pace for a common goal, maintaining the window of opportunity, rethinking the way progress is measured, gathering the information needed to take action, keeping promises made, leaving no one behind, promoting nature-based education.

Prior to DG summit, another article, written by Preetha Banerjee in Down To Earth focused that the World Leader should be aware about one particular survey report, carried out by the age the Children that between 2023 and 2030, one child born every second of next even year to be turned in sub-Saharan Africa if DG progress not accelerated.

The Urgency of This Evaluation :

In this short evaluation document, the present author feels it appropriate to mention the UN Women Report, Progress on the sustainable Development Goal, The Gender snapshot 2023. It is quoted from the report, which ay," Halfway to the end point of the 2030 Agenda for sustainable Development, the world is failing to achieve gender equality, making it an increasingly distant goal. If current trend continue, more than 340 million women and girl will till live in extreme poverty by 2030, and close to one in four will experience moderate to severe food insecurity." It further adds," With the clock ticking, urgency mount. Neglecting to amplify effort and invest in gender parity jeopardize the entire 2030 Agenda for sustainable Development."

According to ORF report by Vikram Mathur, it has been emphasized that at the SDG Summit held on 18-19 September 2023 in New York, it describes, "Despite the rhetoric universality, the outlined SDGs put the onus on developing countries to improve their environment and social indicators and gloss over the responsibility of wealthy nations which historically consumed a large share of global resources. Thus, to achieve the Sustainable Development Goals (SDG), it is now essential that we place a greater emphasis on sustainability consumption goals (SCGs). SDG 12's focus on sustainable consumption is seen as having not been adequately addressed at the Global Platforms. He continued by saying that India's Misson Life (Lifestyle for Environment) program had also received recognition at the G20 summit. Unsustainable consumption increases waste, emissions, and deforestation, all of which have a significant negative impact on the environment and the climate.

Conclusions :

To conclude this, write up on the interrelationship between environment and the SDGs, it is worthwhile to quote the landmark political declaration made by the World leaders to accelerate 17 SDGs at the 78th UNGA (United Nations General Assembly) meeting - "The 2030 Agenda remains our overarching roadmap for achieving sustainable development and overcoming the multiple crises we face. We will act with urgency to realise its vision as a plan of action for people, planet, prosperity, peace, and partnership, leaving no one behind. We will endeavour to reach the furthest behind first."

Finally, we recall the statement by the UN Secretary – General Antonio Guterres, which says, "With the world watching – including 193 young people in the balcony holding blue lamps of hope- you made a solemn promise. A promise to build a world of health, progress and opportunity for all. A promise to leave no one behind." He further added in his statement, "Yet today, only 15% of the targets are on track and many are going in reverse. Instead of leaving no one behind, we risk leaving the SDGs behind".

You can very well understand how our leaders are performing to protect the Environment and the Humanity as a whole.

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