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Tata Institute of Fundamental Research

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Quintessential Teaching Practice in Teachers Education in 21st Century

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<u>Abstract</u>

A nation's progress depends on the quality of its education system, which depends on teachers, and teaching is regarded as the most respectable of all occupations for this reason. As a result, the teacher plays an important role in both the educational system and in society. However, teaching is not a mechanical procedure. It's complex, challenging, and extremely exciting. The current study explores various Quintessential teaching practices adopted by the teacher's education system and helps to understand key aspects of innovative teaching practices in teacher education. The researcher conducted an intensive search based on keywords in different academic journal databases and different reports published in the recent past in order to achieve an analytical study based on the title of the paper. After making intensive literature study based on the theoretical concept the researcher made a primary survey to know current state of innovative teaching practice used in different teacher training institute in Kanpur District of Uttar Pradesh.Succeeding intensive theoretical study the researcher made an attempt to find out current state of quintessential practice in teacher education. For this research the researcher selected twenty(20) B.Ed. colleges. Sample of 200 B.Ed. trainees were randomly selected for the study. The collective data was further analysed through percentage. At last the researcher concluded that there are specific barriers in our educational system that prohibit teacher education institutions from becoming creative, such as a lack of physical facilities and resources, a lack of dissemination of innovations among teacher educators, a restrictive framework, and a lack of research orientation, to name a few. The authors of this study have attempted to shed light on some of the necessary creative practices for teacher education.

Keywords: Quintessential, Teachers Education, Smart Boards, Flipping Classroom

A Case of Teaching Mystery Grains: Themes in a teacher's curriculum strategy

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In this paper, we characterise a teacher's interactions with an enrichment activity that she conducted with her students. The activity was centred on the connection between the protein content of grains and the quantity of foam that can be formed from soaked grains. In the activity, students predict the protein content of grains, and test these predictions by conducting experiments to measure the amount of foam formed. The activity facilitates student design of these experiments, consistent with characteristics of inquiry curricula.

Previous work has suggested a framework comprising three meaning-making tasks that teachers engage in as they interact with curriculum: reading and understanding the material, evaluating and reflecting on the material and pedagogy, and adapting and enacting the curriculum (Sherin & Drake, 2009).

Our case analysis – based on transcripts of a pre-session interview, audio recording of classroom enactment, and a post-session interview – reveals the teacher's particular approach to these meaning-making tasks. We identified three themes characterising the teacher's engagement with the activity: attention to generic versus specific details in the activity, giving students 'freedom' during the activity, and scaffolding of student thinking.

Furthermore, since the interviews were conducted by the designer of the activity, we were able to achieve a substantial understanding of the two with respect to the above themes. We found that the designer and the teacher remained in parallel planes in terms of their thinking about the unit, similar to previous reports of differences in 'framing' of learning (Heyd-Metzuyanim et al., 2018).

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Key Words – teacher education; curriculum;

Exploring Reflective Practices for teaching and learning :A study of B.El.Ed. Pre-Service Teachers

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Many researches (Pollard, 2008; Dewey,1933; Schon,1983) assert that reflective teaching is an essential attribute for the professional development of teachers. The paper explores how pre-service teachers pursuing B.El.Ed, a four year undergraduate professional teacher education programme reflect upon their primary and middle school Internship experiences. Ten pre-service teachers were randomly selected and interviewed through semi structured interview guide. The inquiry based narrative approach was implemented to collate the data. The responses were analysed on the basis of Pollard's work on reflective teaching and Carl Roger's response to Dewey's work on reflective thinking. The analysis of the responses indicated that pre-service teachers were continuously thinking about their experiences related to planning and execution. Further, on the basis of these experiences, they were making changes in varied aspects related to their teaching and learning. However, it was revealed that they were not reflecting during the classroom teaching. . It was also evident that they were developing a habit of exploring evidences to develop one's own theory for their own professional growth However, from the responses, it was apparent that prospective teachers were explicitly and precisely not clear about what is reflective thinking and did not appreciate the rigour of the systematic process of reflection. The study argues that pre service teachers need to get an opportunity to learn more about contemporary perspectives of reflective teaching.

Key Words – Reflective teaching, Primary, Pre- Service teachers

Status of Science Education in Rural India:
Study of Secondary Schools in Eastern Districts of Uttar Pradesh

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The issue of equity and accessibility are considerable matters to be of concern in our education system. These issues are more prevalent in the realm of science education as the existing discourse concludes on disadvantaged groups (for instance girls, learners with disabilities (VI), those who belong to remote/rural/tribal areas) in science. The accessibility issues pertaining to science education lie both on the physical and content level. However, the government of India has taken many initiatives to bridge this gap, still, these initiatives must be kept in a critical lens as it is not visible on the ground level as it should be. Thus, taking the stance of democratization of science education to advocate the principle of science for all, the present paper critically examines issues and challenges in science education in rural Indian classrooms and how teachers and students are coping with it. For this, the researcher has visited Government high schools located in the eastern districts i.e., Varanasi, PratapGarh, and Mirzapur of Uttar Pradesh, India. The data were collected from 11 schools (five Varanasi and five Mirzapur and one PratapGarh) and through field observation (non-participatory observation), semi-structured interviews of teachers as well as students. 30 students and seven teachers were interviewed and their responses were then thematically analyzed. This is an ongoing study initiated in February 2021 and aims to cover other eastern districts of eastern Uttar Pradesh such as PratapGarh, Sonbhadra, and Allahabad to unfold the issues in science and science education.

In this regard, the researcher presents the ground realities originated through observation that maximum visited schools don't have science and mathematics teachers at the secondary level, girls were less to pursue science as compared to boys and had a narrow understanding of career prospects in the discipline due to limited exposure. Apart from that, learners who are not pursuing it but wish to, belongs to low socio-economic background and consider it as "difficult". And dispiritedly, teachers' response to their conception of the nature of science was superficial and the pedagogical approach was limited to the traditional medium of teaching; majorly due to lack of resources.

Moreover, due to the COVID-19 pandemic, the education of these students has been deeply compromised. The huge shift to complete offline to a completely online mode of education has influenced the nature of science classroom discourse. This paper incorporates some serious concerns and recommendations & policy reformations on the behalf of the existing situation of science education including encouraging science for all, immediate recruitment of teachers, releasing funds to improve lab facilities, etc.

Keywords: Science Education, Science in Rural India, Equity, Disadvantaged Learners, Science Education Policy

Effectiveness of Nearpod in promoting student engagement in remote learning

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Student engagement is the major concern of remote learning temporarily adopted by the schools due to Covid-19 pandemic. Traditional remote teaching has limited possibilities to ensure the student engagement. As an effort to find the solution, the effectiveness of interactive digital application Nearpod, in promoting remote student engagement, was studied by comparing it with the parallel traditional remote class using two group pre-test post-test design on Grade 9 (CBSE) students (n = 124) for science subject. Independent t-test showed statistically significant difference in the student engagement [t (121.88) = 7.919] and learning performance [t (121.52) = 7.403] between Nearpod powered and traditional remote classes ($p<0.001$). Nearpod powered remote class showed significantly higher student engagement and improved learning performance as compared to traditional remote class. Very strong positive correlation (r = 0.94, $p<0.001$) between student engagement and learning performance indicated dependence of improved learning performance on higher student engagement. Newly developed Remote Student Engagement (RSE) scale consisting forty-five Likert type items based on learning satisfaction, learning management, learning performance and transactional distances showed very strong correlation (r = 0.97, $p<0.001$) with the observed student engagement; signifying its initial validity as an effective tool to measure remote student engagement. Sub constructs transactional distances of RSE scale strongly and positively correlated with the student engagement as well as improved learning performance which indicated that the reduced transactional distances enhance the student engagement and thus improves the learning performance in remote learning. Present study concluded that Nearpod is an effective digital interactive application to reduce transactional distance, promote the student engagement and improve learning performance in remote class. It also suggests the large scale implementation of RSE scale for further validation.

Keywords: Nearpod, student engagement, remote learning, Remote Student Engagement (RSE) scale

Analysis of Learning Outcomes in Teacher-made Test Items for Class VIII Science Curriculum

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The present study intends to make a comparative analysis of learning outcomes in teacher-made exam questions of class eight science course and specified learning outcomes of class eight science curriculum. It is a common fact that science teachers tend to use test items prepared by themselves more often than standard test items. As most of the elementary level teachers are now trained to use students learning outcomes (Learning Outcomes at the Elementary Stage, NCERT, 2017), so they are expected to use student learning outcomes in their test items. Hence, a research study is undertaken to analyse and compare the learning outcomes identified as per the curricular expectations at class eight level and the learning outcomes used in the assessments. The study is significant to explore the compatibility of the intended learning outcomes of class eight science curriculum, text books developed on the basis of learning outcomes and the test items prepared for assessments and evaluations purpose. Moreover an extended comparison of learning outcomes identified in teacher made questions and the learning outcomes used in standard test items prepared for National Achievement Survey test(NAS,2017) has also been done.

The study includes total three hundred science questions prepared by science teachers of (i) DM school, RIE, Bhubaneswar,(ii) KV No. 1, Bhubaneswar and,(iii) Utkal University High School, Bhubaneswar (BSE), for class eight students between 2017 – 2020. These questions are being analyzed against 20 selected learning outcomes from six cognitive process dimensions mentioned in Revised Bloom's Taxonomy (RBT). The analysis has been carried out with obtained data using descriptive analysis techniques according to RBT. The analysis of cognitive process dimension of the science curriculum's learning outcomes shows the preferred focus for understanding category of cognitive trait and least focus for remembering and evaluating categories. However, majority of the teacher made questions of all the three schools are focused on remembering category followed by understanding. Interestingly few questions were also identified which are not related to any learning outcome level. Surprisingly, both teacher made and NAS test items have no questions that focus evaluating and creating categories.

Key Words - Learning Outcome, Revised Bloom's Taxonomy

Children as Authors: A story of creativity, motivation & metacognition

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Abstract

The Indian education system has an inordinate focus on rote memorization & exam success. Students are often passive participants with little scope for expression of creativity, originality or independent thinking. Innovative teaching and learning programs are being implemented in certain schools, however these are not well researched.

The Earth Authors Program (EAP) is an project based learning (PBL) program in which middle school students write, illustrate and publish storybooks on nature. This research is an exploratory qualitative study of an online EAP implementation with 14 self-selected students in Chennai, India. A key aim of the research was to amplify the traditionally unheard voice of the students to understand their experience. The eventual goal is to use the research findings to create a formal EAP curriculum.

The study used naturalistic research methods relying on descriptive and interpretive analysis of data. The researcher used her practitioner background and experience to describe and interpret the data. Transcripts for the structured interviews, group discussion, journals and assignment submissions were analyzed for patterns inductively and codified for themes. This data was triangulated with the other forms of communication the children used as well as the storyboards, drafts and final books. Recurrent themes were identified and then refined deductively. As with naturalistic studies, the children's direct words were given primacy and are used extensively in the discussion.

Themes of creativity, motivation and metacognition emerge as intertwined in the student narratives. The notion of globally published storybooks was a powerful motivator for the children who viewed writing as a means to amplify their love and concern for the environment. This prosocial motivation sustained engagement in a cognitively challenging endeavour and also drove the children to write highly creative books. In the process, children developed important metacognitive skills.

Keywords: Experimental Teaching, Learner engagement, Project Based Learning, Blended Learning,

Building Scientific Attitude Among Children with Low Functioning Autism Spectrum Disorder: A Case Study

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Abstract

Aim: Children with low functioning autism spectrum disorder (LFASD) are deficit in planning and organization (domain of executive function) which is basis for understanding the law of nature. The present study focused on developing the planning and organization skills through wooden house task games. The study has been conducted on **three children** which diagnosed with LFASD.

Method: In the present study, three children diagnosed with ASD, were taken as the subjects of the experiment. The subjects were given intervention named as **wooden house task games** i.e., four games arranged with increasing complexity. To evaluate the generalizing skills of children, they were exposed to another game name as **"Beautify Home".** To assess the planning and organization skills of children they were exposed repeated (three times) pre-tests on executive function on the dependent variables and also repeatedly (three times) post tested with the same dependent variable. Observations were done through observation schedules by the teacher, parent and investigator. The collected data was analyzed quantitatively as well as qualitatively. Treatments were given for 16 sessions. In this context, the study under investigation followed the **time-series design**. In this study, qualitative method which was followed by quantitatively analysis was used to find the impact of wooden house task games on planning and organization of children with low autism spectrum disorder which is foundation for building the concept of logic.

Description of Intervention: In **wooden house task game**, a wooden house is painted with bright colors i.e., walls painted with red colors and roof with alternative strips of white and brown color. There is a garden outside the house where flora and fauna have grown. At each level of the game, teacher have given different instructions and children will execute it. For example, at level one teacher have given instruction like "put the chair at the center of the garden". In **beautify home game**, plastic modern home with furniture was exposed to the children with visuals of decorated home (as expected by the children to organize the home). The instructor has given instructions to the child i.e., Instruction1: Place the table and chair in balcony, Instruction 2: Place the piano in living room.

Results: Wooden house task games have potential to improve the planning and organization of low functioning children with ASD.

Keywords: Autism Spectrum Disorder, Beautify home game , Executive Function, Wooden House Task Games

How cheap is my sandwich: Mathematics in domestic life

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I asked the students of class VI to work on a project of making sandwiches by themselves during this lockdown and surprise their mothers. I shared with them the ingredients and the instructions to make the sandwiches. They had to compare the cost of making the sandwiches with the price of buying a Subway Sandwich of similar ingredients. They were asked to share the computational details along with the picture of the sandwich made and a family picture along with the sandwiches.
The project was named "Subway Sandwiches".

Purpose of this project:

1**. Social Purpose**

a. Learning how much are the costs of the things they are consuming daily: This project was planned for urban private school students aged 11. The intention was to create an awareness about the price and the value of the food consumed daily.

b. Become a helping hand to mother: During the pandemic I conducted a survey to assess how involved my students are in the regular household works. The following Pie chart shows the percentage of students involved. The result was 1 out of 39 students. Hence as their class teacher and maths teacher my other intention was to make them involved in household chores.

c. A hope to develop better eating habits in the world of online orders: The outside food has always been a part and source of celebration, given the common knowledge that home made food is better! Hence this project also tried to make them aware of the economic and health consequences of having outside food.

d. To be able to see the faces of the children from the picture sent, some of which I saw the very first time: The student strength of my class is more than 40. During my days in the virtual classroom, like many, I also had at least 10 students whose faces I have never seen. So as a bonus I asked them to add a picture at the end of the project. It was great to see that the students who always shied away to switch on their videos, send their smiling faces along with their parents and their sandwich with a little bit of garnishing.

e. Spending some time away from the screen: Due to the pandemic the over usage of phone and laptop has become a concern among the teachers and the parents. The students have become reluctant to write with a pen, they are reluctant to draw with crayons but very much eager to draw with online tools. Cooking is the only thing which cannot be replaced with online cooking! Hence it was an attempt to make them stay away from their screen.

2. **Educational Purpose**

a. Learning of Estimation: We do not teach estimation as a chapter in class! We assume that children have innate abilities.There is a popular question which is asked in the chapter of Set theory; "State whether the following sets are infinite or finite or null - Set of all men above 5m height". The spontaneous question on the students' part is whether the set is finite or infinite! That is in reality they fail to understand that to have an individual of height 5m is very much impossible. And hence assuming possible, they ask whether the number will be infinitely large or not. This problem of estimation is quite easy to clear once a reference is given to them such as the average height of the ceiling in a flat is close to 4m. They suddenly realise and correctly answer that it is a null set. Hence the experience shows that the problem is with the imagery that they carry in their mind

associated with 5m or 1m.

The level of error in estimation decreases with the increase in related experiences.

In this context - if I think that adding two tomatoes will be sufficient for the sandwiches, then what gram of tomatoes I am thinking about. Or if 1 lettuce is required, will the weight of it make it a possible buy? If not, then how many extra lettuce will one get by buying the minimum quantity? It was part of my objectives that students face and deal with such questions by themselves. This showed me to what extent our presumption about their concept of estimation was erroneous.

In textbook learning we learn to use operations separately and sequentially such as problems related to only addition or only decimal etc. In reality, we often need to use all the operations simultaneously and to attain objectives beyond just learning the operations. The objective necessitates the usage of mathematical operations. The project enlightened them on that.

Outcome of the project:

The presentation and decoration of some sandwiches duly manifested the students' passion for cooking. The attached pictures are proof. This is an immediate outcome. The rest needs to be seen in due course!

Some anecdotes!

Most of them chopped the cut vegetables for the first time, and some friendly disasters happened!

1. Cheese was messed up, poured on floor
2. Tomato was squashed
3. Onion flew out of the window
4. Cut a finger

Some feelings shared by the students while doing this project

1. I felt like a chef!
2. First time I made something for my family, it was a great feeling.
3. Cooking became a new found hobby!
4. I could not keep it a secret from my mom, as she heard you giving the instructions in class, so she helped me too. I loved spending time with my mom in the kitchen!
5. First time I went grocery shopping.
6. It was a memorable day!
7. Cooked for the first time!
8. It was very difficult to keep it a secret from my mother.
9. Both my parents are away for work, all the 7 days, so could not do it.

Investigating Collaborative Emergence of Distributed Creativity in Makerspaces

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Makerspaces usually afford Collaborative Making by virtue of their design, where Makers can come together to use the shared resources in that space and influence each other's ideas and design processes. Such shared processes create opportunities for collaborative emergence of 'distributed creativity' via various means, implicitly or explicitly. Collaborative emergence refers to the "emergence of a new product or creative outcome resulting from collaborating groups that are relatively less constrained or completely unconstrained and have unpredictable outcomes, defined by moment-to-moment contingency, influenced by the material resources available, and the interactional effect of participant's action that can be altered by the subsequent actions."[1] The emergent distributed creativity can be attributed to dialogic exchanges, intersubjectivity, context, and viewed as a complex process of interaction between human and non-human actors that occur in a situated environment. In this research, we position creativity as a group level continuous evolving processes rather than an individualistic, mental process. We focus on factors such as interaction of Makers with fellow Makers, tangible tools, available resources, and the design of the space, while they are engaged in the Making activities. We investigate how these factors contribute towards the emergence of distributed creativity in the context of Makerspaces. We use the ideas of distributed cognition[2] for our investigation. This research has implications for the design of scaffolds in Makerspaces for promoting creative and innovative outcomes.

Key Words – Makerspaces, Making, Collaborative Emergence, Distributed Creativity

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Adapting Betelgeuse's Dimming Event to A High School Level Astronomy Exercise

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This article outlines the process of designing a problem for astronomy Olympiad at high-school level, based on a recent curious astrophysical event. Betelgeuse, one of the brightest star in the night sky and a supernova candidate, started dimming in October 2019 and reached a record minimum magnitude in February 2020. This extraordinary event piqued curiosity in professional astronomers, amateur astronomers as well as mass media. The problem presented here, tries to build a quantitative model of the event for the students, based on just high school physics. This problem included three models viz., a stellar pulsation model, an exoplanet transit model and a mass loss event model. The students were asked to calculate few physical quantities or parameters to deduce the most suitable model. The entire process of problem design including constraints involved, alternative approaches explored and discarded and final draft is laid out. Further, based on the analysis of more than 500 student responses, various trends in students' thinking are illustrated. It is hoped that this discussion will serve as a guiding light to fellow problem designers and question setters.

Key Words – Betelgeuse Dimming; High School; Problem Design; Olympiad

Diagnostic Competence of Prospective Mathematics Teachers: Supporting Struggling Learners in School Mathematics

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Abstract

Despite having the right to education with equity and access to quality mathematics education for all, the number of students worldwide is trapped in a vicious circle of unsatisfactory performance to achieve the learning outcomes in mathematics as highlighted by the national and international policy reports (NAS 2017; ASER 2018; & PISA 2018 & TIMSS 2019). Recently, the Ministry of Education, India has introduced 'Structured Assessment for Analyzing Learning levels' (SAFAL) a competency-based assessment to ensure the students' progress on foundational skills and learning outcomes by providing diagnostic information about students' learning to teachers, schools, and their parents (NEP, 2020). Therefore, against the backdrop of a large-scale heterogeneity of students in Indian classrooms, the diagnostic competence of teachers/prospective teachers, plays a pivotal role to provide a remedial intervention for those who may be at-risk for struggling to overcome the situation. Therefore, forty-four prospective mathematics teachers of central institutions (final year trainees of teacher education programme) were selected as the sample of the study. A self-developed test (paper-and-pencil) based on situation-based items from arithmetic branch of mathematics at middle level was used to assess diagnostic competence of prospective mathematics teachers. The following aspects like content knowledge (CK), pedagogical content knowledge (PCK), error analysis ability, and remediation were considered during the assessment of diagnostic competence of prospective teachers. Qualitative analysis was used to analyze the data. The result showed that prospective mathematics teachers showed a significantly lower level of diagnostic competence. Ergo, a support system should be developed for enhancing the diagnostic competence of future mathematics teachers and prospective teachers. Educational implications and directions for further researches are outlined.

Key Words: Diagnostic competence, prospective mathematics teachers, struggling students, learning outcomes

Situating the Aspirations of Students in Coaching Centres: A Qualitative Study in Delhi

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This paper attempts to understand the aspirations of students' vis-a-vis the coaching industry for STEM in the neo-liberal context. It focuses on how and why some specific professions from STEM disciplines are preferred over others. The neoliberal society has shaped and influenced education, subjectivities of individuals and their lives. Elite institutions of higher learning such as IITs, AIIMS are perceived as pathways for a better future, capturing the imagination of many students. Aspiring to become a part of the global knowledge economy, lakhs of students compete for a limited number of seats. In this scenario, the profession specific coaching industry comes as a quick targeted remedy to prepare aspirants for entrance examinations and is advertised as a requisite step. This multidimensional qualitative study adopts Bronfenbrenner's ecological systems theory (1979) with a sociological lens, where an individual is located at the centre and is impacted by their educational ecosystem. This ecology locates education in the neoliberal context to understand the interwoven nature of political and cultural aspects of education (Apple, 2006, 2019). In order to understand the phenomenon of coaching culture, competitive examinations, and the popular media role in the field of education, a mini case study of 11 coaching institutions was conducted in Delhi, India. Data extracted from observations, interviews, digital social media platforms and artifacts are critically analysed. Key findings emerging from cross case analysis indicated that the aspirations of young students for specific professions have blurry boundaries and are influenced by the neoliberal context. The specific findings of the study indicated the role of coaching as an equaliser for the students, hierarchies between IIT-JEE and NEET entrance examinations, market trends shaping career aspirations, reflection of the 'trendiness' of engineering as one of the dominant professions and switching from engineering to medical coaching and vice-versa. The study has implications for educational reforms in school and higher education in areas of career counseling and for developing independent and critical thinking skills among students.

Key words: Medical, Engineering, Profession specific coaching industry, Neoliberalism.

Aims of and Student Aspirations for Vocational Education

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Vocational Education (VE) has been a constant matter of education policy concern in Indian context. Different policies have stressed on the need for introducing VE right from the school stage. However, VE has gained much more policy interest in the past one-decade. The idea of VE has also undergone a change especially as global knowledge economy has strengthened the policy view of humans as capital. This paper examines India's national level education policy thrust on preparing a skilled workforce - largely articulating skilling as the primary aim of education. It also critically engages with the policy thinking that makes a distinction between the aspirations of the 'poor' and that of the elite and accordingly argues for streaming students in differential educational trajectories. It draws from the data, collected from a sample of 103 Delhi Govt Schools (approximately 10% of the total population). Students of class XIIth were sampled using systematic sampling. In total 3026 students were included in the sample. Data was collected with field investigators using structured questionnaires and that also included some open-ended questions. The data collected was analysed statistically only as the data set was large. As it was an exploratory study, the statistical analysis was limited to descriptive analysis including measures of central tendency and variability were used. Data demonstrates the student aspirations for a liberal higher education and white-collar professions as against the official narrative. This data also helps in understanding how the policy interact and shape student's aspirations. To engage with this mismatch between policy narrative and student aspirations theoretically, the paper draws from the capabilities development approach and human capital theory in education.

Key Words – Vocational Education, Education Policy, Higher Education

A Call for Critical Investigation of Computing Education

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Abstract – Computing is continuously penetrating other disciplines while establishing digital infrastructure and designing systems that shape people's everyday lives across the globe. Recognized as a key literacy, computing is being enthusiastically integrated into formal school curricula and other informal programs offered to K-12 students. This excitement is reflected in recommending computing for middle school students in the recent National Education Policy (2020). However, evident across design and policy efforts is a limited vision for learners' gains from these experiences. With a majority of learning materials and assessments oriented towards preparing learners to contribute to the computing labor force eventually (e.g., programming environments chosen, learning activity designs, assessment rubrics), they lack any critical evaluation of technologies, their relationships with communities, societies, state (e.g., installation of facial recognition softwares in railway stations), industry, and the harms they perpetuate on the marginalized groups (e.g., mobile app-based COVID vaccination distribution that is leaving behind rural populations).

During this talk, I propose to share findings from a preliminary qualitative analysis of a U.S. high school computing classroom to highlight:

1. How the teacher weaved in conversations about communities, societies, and the limitations of technology while making and programming Arduino projects?

2. How students engaged at the intersection of computing and society?

3. How did a constructionist Arduino programming introductory curriculum afford opportunities for critical conversations?

Specifically, the final project which involved making and programming sensor-based interactive artifacts allowed for specific conversations about users and testers, and how they shape design decisions and have implications for communities and societies. Findings from this analysis should serve as "objects-to-think-with" and answer questions such as what does it mean to engage K-12 students critically within computing classrooms in India and imagine future design and research efforts in that direction.

Key Words – computing education, criticality, K-12 education.

Environmental Studies Curriculum of India: Analysis from Content Perspective and Suggestions for its Further Development

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Environmental education has been a part of the informal education system of India. However, the Supreme Court's (SC) judgment in 1991 based on MC Mehta's petition was instrumental in bringing environmental education into India's formal education system, such as schools and colleges. Environmental studies was introduced as a compulsory subject at the Bachelor course in colleges. This study focuses on the topics and the content included within the University Grants Commission's (UGC) developed curriculum for the Environmental Studies post the SC verdict. We have tried to explore and critically analyse the topics and their contents included within the subject. The idea is to discover whether each topic and its contents are not abstract and presented along with their evidence, and also explicitly achieves the goal of connecting the students, belonging to both science and non-science backgrounds, to their environments. The study will consider the inclusion of relevant socio-environmental issues existing in India and the limitation within the content and will try to explore the possibility of reframing the topics and contents in a useful manner than the current existing framework.

Key Words – Environmental education; Bachelor course; Curriculum; Limitation and reframing of the topics

Notion of Children's Agency in Curriculum Documents

Abstract

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Key Words – Children, Children's agency, Policy documents, NEP 2020.

This work is an attempt to understand the conceptualisation of children's agency and participation in National Education Policy 2020 and the shift in the discourse around childhood that this conceptualisation reflects, particularly post National Curriculum Framework 2005.

The nature of adult-child relationship is studied from multi- and interdisciplinary perspectives with child's voice, agency and participation as key concerns. This paper draws from the literature that includes theoretical works of Aries P. (Centuries of Childhood, (1962)), Neil (Summerhill, (1960)), Prout (Constructing and Reconstructing Childhood, (2003)) and several others.

The study is based on the content analysis of the NEP 2020, with a-priori categories of analysis drawn from the NCF 2005. Two tables are used to classify the collected data into the themes designed after an in-depth literature review. The categories are chosen based on their presence in the literature that discusses children's voices and participation and their relevance with respect to the child's agency and childhood.

The major findings indicate that despite inclusion of the terms like 'joy', 'fun' and 'activity' based learning, NEP 2020 visualises children as passive subjects lacking a meaningful voice and agency. In the Policy, education is largely envisioned as the instrument for developing knowledge workers for the global economy and the scope for understanding a child as an individual and critical social actor is also restricted.

(Re) Reading National Policy on Education 2020 Vis-a-Vis Neo-liberal Rationale: Understanding Structural Shift in Higher Education

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Abstract

India gets its new National Education policy after three decades. The promising policy document is loaded with several recommendations with a vision of making India a knowledge power competing in the global platform. The policy document is also deeply rooted in India's glorious past. But the policy recommendations also need a critical reading without undermining its positive sides. This paper has attempted to critically understand the underlying fritters of recommendations on higher education. The paper re-reads the policy document and analysed its one-dimensional view towards higher education that is implicitly moving towards centralisation. Destabilising the existing bureaucratic system, policy proposed a complete structural shift which is in a way anti-federal. The paper has also illustrated the neo-liberal rationale of National Policy on Education-2020. Policy advocates a 'state engineered market' where higher education institutions (HEIs) will compete for funding. HEIs will be bifurcated in three different categories and will be given the status of graded autonomy. Keeping in view these possible changes in the system, this paper would like to read between the lines of the policy document considering deep rooted pre-existing system of the country as well as ground reality. So, the two folded objectives of this study are to understand the nuances of structural reformations in the system and how far these reformations are keeping the federal structure intact. At the same time, another objective of this article is to explore the neo-liberal approaches that the policy document flags in the proposed higher education reforms.

Keywords: Governance, Structural shift, neo-liberal rationale, graded autonomy

Analyzing the prospects and challenges of Multilingualism in NEP 2020 and Science Education: A critical review

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Abstract: *National Education Policy, 2020 has placed great importance on multilingualism in learning for both private and public institutions. Specifically on the teaching of the mother tongue/regional language is favored to the extent possible. It includes subjects like social sciences, sciences and also mathematics. At the same time, English has become the global language for scientific communication (Grabe,1988). The development of English as the international language for science (EILS) and the focus of NEP 2020 on the regional language brings forth many questions which needs to be discussed critically in order to successfully implement the policy and harness maximum benefit out of it. The present article aims to critically understand the nuances of the multilingualism aspect of the NEP 2020 and discuss the potential prospects and challenges.*

Keywords: National Education Policy, Multilingualism, EILS.

Examining the "New" Philanthropy and its implication for Education

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From the 19th century onwards, influential philanthropists have changed the way philanthropy had

been practiced. They endeavoured to distance themselves from conventional notions of charity and charted a different course. Philanthropy has since developed as a more focused and strategic activity. New philanthropy is "hands on" approach to the use of donations. The philanthropists now want to actively engage in the way the project is managed. This phenomenon has been termed as "Philanthrocapitalism". It is a belief in the benefits of transferring business methods to the social sector. So, it is no longer just about the charity, instead it has come to acquire the character similar to that of a capitalist functioning. It involves employment of business strategies and methods, emphasizing evaluation, performance oriented and promoting healthy investor-investee relations.

New philanthropists expect to see returns on their donation. There is an emphasis on visible outcomes and measurable impacts. They set specific goals which are time bound. The philanthropy allows private actors to act in public ways. The new philanthropy is an amalgamation of both public and private sector's characteristics.

The corporate's entry in the educational sphere has been credited for giving a greater push towards privatisation and marketisation of education. The greater participation of private actors and organisations in the public education has been seen as a deliberate attempt of the state to move away from public funding and public provisioning. This has created "quasi-markets" in state-funded services. The NGO's funded or run by corporates apply the principles of market i.e. competition, choice and efficiency through their interventions in the education sector. The present paper seeks to underscore the impact of corporate philanthropy in the sphere of education. It throws light on the usage of corporate methods in the sphere of education and its implications.

Key Words- Corporate Philanthropy, Privatisation, Marketisation

Teacher education in national education policies in India: A comparative analysis

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Globally and nationally, teachers have become one of the central concerns of education policymaking. One of the key reasons for such concern is the growing emphasis and attention on learning outcomes and their relationship with the quality of teachers. Further, the literature points out that "good teacher quality is seen as imperative to meet the changing landscape of social and educational aspirations and the demands of the global knowledge economy" (Cochran-Smith, 2013; Sharma, 2019). Due to this, teacher and teacher education has become an important policy issue. In the context of India, despite being one of the important issues at the policy level, there is very little attention given to the policy context of teacher education, as most of the research focuses on issues of teaching-learning, teachers absenteeism, teachers' agency.

Various national level policies of education such as National Policy on Education (NPE) 1968, National Policy on Education (NPE) 1986 and the recent New Education Policy (NEP) 2020 have envisioned teachers and teacher education. However, there is minimal understanding on the comparative study of the three education policies with a specific focus on teacher education. This paper will do a comparative analysis of three national education policies in India to understand and identify how these policies envisioned teacher education's aims, institutions, programmes and the idea of good teacher/ teacher quality. The paper aims to highlight the continuities, discontinuities, shifts and trends in the envisioning of teacher education in the selected three national education policies. The paper will contextualise these comparisons in the larger socio-economic context of the nation and the broader goals of respective education policies. This paper will use a document analysis method to analyse the selected national education policies. This paper will be of significance as it will highlight the policy context of teacher education in India.

Keywords- Teacher education, education policy, comparative analysis

Unsettling knowledge narratives through communities of practice: Exploring sustainable transformations seeded through the Andhra Pradesh community-based natural farming

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Green revolution in India have resulted in severe loss of agro-biodiversity, and contributed to a vicious cycle of farmers' poverty due to dependence on resource intensive practices of cultivation. Despite alternative field experience of practitioners and farmers, these dominant practices have become institutionalised, leading to a knowledge-practice lock-in. Mainstream scientific institutions also suffer from epistemological inertia in moving towards agroecological knowledge systems. Alternatives to the dominant knowledge involve recognising the interconnections between sustainability and livelihood issues and building patterns of production and consumption based on mutual co-existence.

This paper highlights the knowledge-practice gap and the sustainability-livelihood link, while tracing the innovative initiatives of an Indian grassroots organisation known as Rythu Sadhikara Samstha (RySS) (Corporation for Farmers' Empowerment). RySS implements the Zero-Budget Natural Farming (ZBNF) Program of the Government of Andhra Pradesh. This unique program is redefining farmers' relationship with the land through implementing a host of practices derived from agroecological practices. RySS program does this with the help of young people known as 'Natural Farming Fellows' (NFF), who are trained to facilitate the transition of farmers to ZBNF compatible practices. Interestingly, most NFFs are agricultural graduates trained in the mainstream knowledge systems of agri-development and extension.

Through detailed interviews with 12 NFFs and their facilitators, this paper explores pathways of grassroots capacity building through a 'communities of practice' framework. This study offers an empirical lens to understand how these young graduates compare and critique their prior knowledge with their field experiences. Their narratives foregrounds possibilities of ground-up dialogues needed to initiate institutional changes focused on ecological wellbeing.

The focus of the study was an exploration of experiences and perspectives that Natural Farming Fellows developed through their interaction with the field and farmers. The

exploratory nature of the study led to the use of an interpretative framework, using qualitative techniques. 12 NFFs (5 Female, 7 Male) interviewed in detail, along with program co-ordinator and associates, who help in facilitating the programme. Attempts were made to ensure gender representation and geographic diversity. Additionally, written responses were collected for a few follow-up questions to help participants respond at their convenience be more deliberative without feeling any pressure to answer in real time. Interviews were transcribed and the transcripts were repeatedly read by the researchers, followed by highlighting relevant quotes with different tags with a specific focus on socio-cultural factors, situations and context. Member check was done to check the ensure validity of the transcripts. Secondary data in the form of reports, manuals and training materials were also analysed to substantiate the findings, and validate the responses. Social media posts by the NFF group were also chronicled and documented.

Key Words – Communities of Practice; socio-technical regimes; Natural Farming; Institutional Innovation

Nature of scientists: Interrogating the subjectivities of scientists and graduate researchers

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The paper builds on published work (Mohan & Kelly, 2020) and on dissertation research that seeks to understand the ways in which individuals are socialized into research communities in the sciences. Framing research communities as concerned with the production of knowledge objects with distinct epistemic cultures (Knorr Cetina, 2009), the paper looks to analyze the ways in which the nature of science, taken as a cognitive-epistemic and social-institutional system, discursively effects the kinds of practices that are deemed productive within the community. Specifically, the paper proposes a change in analytical focus away from considering the community as a singular entity on which sociological analyses can and have been historically performed, to focus on the individuals within these communities, who perceive, respond, and react to a dynamically evolving epistemic culture with its own 'instrumental, linguistic, theoretical, organizational, and many other frameworks' (Knorr Cetina, 2009, p.10). From an educational perspective, the paper fundamentally critiques the kinds of epistemologies that are at the foundations of most undergraduate science education frameworks, across institutions internationally, which rely on a static, well-defined, and decontextualized characterization of scientific practice. The paper urges a reconceptualization of the epistemic foundations of education to consider an epistemology *for* science as it is contextually established in everyday scientific practice at macro, meso, and micro levels, building from existing frameworks in the family resemblance approach to the nature of science (Erduran & Dagher, 2014), to focus on the individual experiencing scientific practice

as a member within this community. The paper concludes with recommendations for educational frameworks that can incorporate aspects of both these epistemologies, viewing these as fundamental to better prepare students to become socialized into the subject of the ideal scientist across different epistemic communities.

Key Words – epistemology, nature of science, graduate education

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Tyranny of *T.rex*: Visual Rhetoric of Prehistoric Life

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Nineteenth-century biologist Ernst Haeckel's tree of life depicted 'lower' organisms at the base of the tree and 'advanced' organisms progressively higher. The tree illustrated the view that evolution is a drive towards greater complexity, synonymous with progress. Modern biological thinking construes evolution as a process of diversification, without any drive towards 'complexity'. Modern biology textbooks explicitly state that all present-day organisms are equally evolved. However, I argue that the evolutionary hierarchy persists in the textbook discourse in many subtle ways. To uncover this hierarchy, I perform critical discourse analysis of popularly used high-school and undergraduate biology textbooks. I analyze the structure of evolutionary trees, the choices of 'prototypical' organisms of different taxa and different epochs, and the rhetorical choices made while depicting or describing these organisms. The ghost of Haeckel's tree still influences the textbook narrative, as organisms successively 'lower' on the tree are associated with progressively earlier eras — for instance, reptiles are just below mammals on the tree, and 'Age of Reptiles' is suggested to be preceding the 'Age of Mammals'. The rhetorical choices made while depicting dinosaurs, such as their fierce expressions, portray the prehistoric reptiles as 'dominating' the landscape. Choices regarding the appearance of dinosaurs suggest them to be similar to present-day reptiles, framing modern-day reptiles as vestiges of the ancient past. Descriptions of proto-mammals (earlier referred to as 'mammal-like reptiles') — who arguably 'ruled the earth' before and with the dinosaurs — remain rare. I argue that the definition of early synapsids as 'proto-mammals' instead of mammals, and their under-representation in the narrative of the pre-historic past, are not arbitrary choices — they serve the ideological purpose of making mammals seem 'modern'. I conclude with some implications of the interplay of ecological and evolutionary hierarchies and consider what they suggest about our place on the earth.

Keywords: hidden curriculum in biology; biology and ideology; the rhetoric of evolution; visual rhetoric

Do social welfare inclined physics undergraduates feel alienated from the technical culture in physics? An Exploration!

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Within STEM disciplines, technical knowledge is prioritised over its social impact, assuming science and technology automatically and always benefits the society, hence hindering disciplinary practices from being subjected to critical examination for potential harm towards the society. Multiple studies conducted in the US (Cech,2014; Schiff,2019) support the claim that social responsibility is under-emphasised in the STEM curriculum and ethical training is limited to code of conduct at a personal level. Such a disengagement has been found to be one of the reasons for students discontinuing their programme or choosing a more socially responsible career path.

However, all such work has been done mostly in engineering, with little to no attention paid towards such phenomena in pure science courses, specifically physics. As a physics undergraduate student, the lead author was able to have casual conversations/group discussions with classmates and collect their experiences.. Many have expressed a feeling of dissociation towards the programme but none were able to point out a specific reason behind it. Many have voiced their discontent in continuing further education or career in physics, meanwhile some are unbothered as they treat the physics degree simply as a stepping stone towards social welfare driven careers, despite proving their capability in physics. This initiated a sense of curiosity to explore more about the culture surrounding the degree programme and its curriculum. In this study, we analyse focus group conversation with students to understand why, when and how these students experience a conflict with the alienation of their values in the classes they attend and the lessons they learn and the consequences of such detachment. We will present the details of our preliminary research design, potentially involving focus group sessions with undergraduate physics students, expecting feedback and suggestions to improve upon it.

Keywords: social responsibility, belonging in physics, alienation, values

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Cultural Astronomy of Bhil, Pawara and Kokna tribes in western India

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Abstract

We report on the astronomy rooted cultural practices of three tribes of western India - Bhil, Pawara and Kokna situated in north-western Maharashtra. These tribes have their own unique connection with the sky which is influenced by their surroundings. Their astronomical lore is distinct from the astronomical lore in mainstream Indian culture, but shows a connection with other central Indian tribes. These communities determine local time, rain periods, harvesting periods, etc based on certain astronomical phenomena as well as the rising and setting of certain constellations/stars. Their level of astronomical knowledge provides interesting clues about their shared cultural roots.

In this paper we will also talk about our experiences and challenges of data collection and how they led us to conclude about their astronomical beliefs.

An exploration into campus lives of queer STEM students in India

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The experiences of students from marginalized sexual and gender communities such as lesbian, gay, bisexual, transgender, queer (LGBTQ) youth are severely under explored within education research, in general, and in STEM education, in particular [1] . Various reports on the conditions of LGBTQ students in STEM education have come out in recent years [2,3,4]. The attempts by LGBTQ scientists in queering science is also notable [5]. The authors identify as a lesbian trans woman and gay non-binary person respectively. Their experiences indicate that on-campus queer-supportive spaces play a big role in their academic experience. A recent conversation by students in IISER pune shows this as well [6]. For this exploratory study, we investigate how five undergraduate and masters STEM students who variously identify within the LGBTQ umbrella relate to and experience queer spaces on campus. We are especially interested in what role participation in these spaces play in the students' academic journey in science, how they see science spaces in contrast, and what spaces, if any, allow them to be their whole selves (whatever that means to an individual participant). To do this work, we draw on insights from queer methodologies built up by qualitative researchers from the LGBTQ community [7,8]. We will be doing qualitative research using interviews using online video conferencing tools. The talk will focus on the ethical and design issues faced by the researchers. We will also talk about researching in an already traumatised population and the risks involved, with particular focus to the queer population.
Key Words – LGBTQ studies, queer theory, ethics, qualitative research

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Understanding perception of adolescents about themselves and social factors affecting them

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Adolescence is that stage of life where individuals begin to recognize and think about themselves and the events happening around them especially that are abstract in nature. They begin to observe and form opinion on what they think or feel about a particular issue. It is one of those phases of life that witnesses a peak of growth in physical, emotional arenas. One of the reasons why we are doing this research is look into identity formation process of adolescents which is a significant developmental aspect of adolescence, wherein how do they form opinion about themselves or about a particular issue and how that is influenced by what others think about it.

In our intervention with Grade-9&10 students rural government schools in Berasia block of Bhopal district and Shahpur block of Betul district, we are attempting to analyse the thought patterns of adolescents on themes such as gender, self-awareness, social awareness, career choice and digital literacy. We are trying to delve deeper by understanding the gender biases that children hold, what do they want to choose as a career and their aspirations about it, how do they express the emotions of anger and fear, what are some of the societal customs or practices held in their villages, how do they think they are affected by the growing technological use particularly after the pandemic. What are the perceptions children hold on these themes? Is there any pattern in the way children have responded during the assessment? We selected these themes based on the 21st century skills listed by OECD (Organization for Economic Co-Operation and Development) and we have tried to develop an understanding on these themes in the rural context of Adivasi populated (Shahpur) and Muslim, Dalit populated (Berasia) regions.

The methodology of the research study is qualitative in nature as we try to understand the notion of how adolescents perceive certain elements affecting them and the role of socialization during this process. This study has been conducted through a written assessment with multiple-choice and descriptive based, which consisted of questions on various themes such as self-awareness, gender, digital literacy and career choice. While conducting the assessment we made sure that we will not convey anything about the question in order receive unbiased responses from children. The written assessment has been carried out with 577 adolescents in four Government High Schools of Berasia block (Bhopal) and three Government High Schools of Shahpur block (Betul). The research participants include students of Grade-9 and 10 who are 13-15 years in age. These are government schools we are working and our team gets to interact with these adolescents.

We have completed conducting the assessment and through the description we analysing the pattern in adolescent's responses. We have been able to recognize that especially in the theme of career choice, adolescents have highlighted about wanting to be a "do-gooder", be independent, how there is a strong need to make their parents and community feel proud, which brings the fact that there is a necessity to gain social validation which in turn has seen to affect adolescents' choice of who do they want to become. The question about how socialization influences the schooling process and their identity is one of the dimensions we are exploring through this study.

Key Words – adolescent identity, thought patterns, twenty-first century skills, physical and emotional development

Disability and Women in the Realm of 'Supreme' Science

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Abstract

Historically, making a 'perfect human race' is an idea of science. This idea has discriminated against the people of diverse race, gender, religion, abilities and linguistic backgrounds. As a branch of science, medicine has its dominance over the study of disability until today. Medical model has played a decisive role in stigmatizing disability and persons with disability. Similarly, science has prejudices towards women. Many researchers tried to prove feminine body and mental abilities as inferior in comparison to male body and mental abilities. The major aim of this paper is to highlight the attitude of community of science towards the disability and women and in turn being responsible for more discrimination towards disabled women. This aim will be achieved by reviewing the literature on the intersectionality of disability and gender. Furthermore, the argument is supported by analyzing the chapter on 'Principles of Inheritance and Variation' of class 12 biology textbook. This chapter describes various disabilities as disorders or diseases. It is in contrast with the humanistic provisions of The Right of Persons With Disabilities Act, 2016 which enlist all these disabilities. Hence, people must question the scientific community that what is the foundation of deciding the standard of 'ideal body'? When science states that progeny receives genes from parents and during the process of reproduction variations take place as a result of gene pooling, then why are only few variations represented as disorders? These kind of questions evoke people to think that science textbooks need to change the vocabulary in order that such textbooks can be created which does not describe disabled students' disability as disorder and students who are not disabled can get the opportunity to escape the dichotomy of categories like abled- diasbled or normal-abnormal.

Key Words- Disability, Feminist Perspective, Science Education.

Intersectionalities, Experiences and Marginalization in Higher Education

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English education is seen as an instrument which will help Dalit-Bahujans to emancipate, empower them linguistically and help them fight against injustices and oppression borne out of the caste system. Thus, it is a way to achieve equity and social justice, however the lack of institutional support often confronts Dalit-Bahujan students and pushes them to become non-being in the classroom. The lack of facilitative pedagogical structures in higher education not only excludes the disadvantaged communities, but also impinges upon democratization of knowledge and process of knowledge production. While English education is considered as a tool for social mobility and emancipation on the one hand (Faust & Nagar, 2001; Ilaiah, 2013; Ilame, 2020), on the other it is used to maintain the social structures of caste, class and gender (Mohanty, 2017; Manjrekar, 2003; Ramanathan, 1999). In this context, the present study attempts to understand the everyday experiences of Dalit-Bahujan students in higher education.

This study explores the following questions: How do students from Dalit-Bahujan backgrounds experience English medium education? How do gender and caste intersect with this experience? How does socio-economic background of Dalit-Bahujan students influence their access to/participation in higher education with respect to English medium education? How does university facilitate the inclusion of Dalit-Bahujan students in providing quality English education?

This study has been conducted in an English-medium higher education institution based in Delhi, India. It is a qualitative study based on an in-depth interaction with Dalit-Bahujan students to understand their everyday experiences and in-depth interaction with university bodies to understand the institutional mechanism, especially for the inclusion of Dalit-Bahujan students. I conducted face-to-face interviews with all the participants through semi-structured interview protocol. It included a structured component for collecting demographic data and indicative questions that served as themes for open-ended discussions. One of the reasons for using semi structured protocol was to ensure that all relevant background information is collected. Since different programme levels and constituents were involved I wanted to ensure that aspects of data collected connect with each other. Along with conducting interviews, I analyzed some of the official documents/reports of the university as well as participated in the discussions, activities and events of the students.

The findings of this study reveal the experiences of marginalization in higher education and considerable gap between the socio-economic backgrounds of the students and institutional knowledge and pedagogical structures. Further, the findings on intersection of gender and caste reveals the unequal access to English medium education in society where boys from upper caste-class

backgrounds get easily into English medium education institutions and their education is favoured as compared to girls. While on the other hand, boys and girls from lower caste backgrounds either get into state run government schools or low fee charging private schools. Given the unequal access to education situated in the schooling context of Dalit-Bahujan students and the marginality of caste, class and gender, the linguistic challenges become more visible when they reach higher education.

Key Words – English education, marginalization, knowledge production, pedagogical structures.

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Understanding Geography and Astronomy through shadow observations

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In the past decade, the phenomenon of Zero Shadow Day (ZSD) has been popularized by ASI-POEC (*Zero Shadow Day – ASI POEC*, 2021) and other groups across India. These initiatives usually take the form of one day events on local ZSDs where the general public are invited to observe their shadow and are led through an explanation of why/when/where ZSD occurs.

A commonly held belief is that the sun is directly overhead at noon *every day.* The concept of ZSD, a day when one's shadow is zero, often needs more detailed explanation and understanding of celestial motion, both actual and apparent. Misconceptions about the celestial motion of the sun have been reported in various age groups, ranging from elementary school students (Plummer, 2009; Trumper, 2001) to pre-service teachers (Trumper, 2006). We propose that observing and measuring shadow lengths over different times scales can help students understand the apparent celestial motion of the sun, and its variation with seasons and geographical location.

As part of the Vigyan Pratibha programme, we are developing units for students centred around these problems. We designed the units so that students (1) engage in direct observation and measurement of shadows and (2) analyse the data they gather. To reduce barriers to student observation, we tried to ensure that: (1) measurements required are simple and resource-inexpensive (2) measurements can be taken individually (3) if required, measurements can be shared betweens schools/students in different locations.

We considered it important that teachers be involved at various stages of the development process, including unit design, classroom trials and revisions. In the past year, we have worked online with

teachers towards developing and testing these units. In initial trials, using these measurements and some diagrams, we tried to connect changes in shadow length to the celestial motion of the sun, and concepts of rotation, revolution and tilt of the earth.

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Key Words – astronomy, celestial motion, shadows, ZSD

A Qualitative study of Education Officials' Perceptions of the Effects of Caste, Poverty and Gender on School Participation and Transition level of Scheduled Castes and Scheduled Tribe students in a state in Northeastern India

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This study aims to examine the perceived effects of the main factors that contribute to the current status of the Scheduled Castes and Tribes students and the educational and social policies that are facilitating, or constraining, progress in a state in Northeastern India. A qualitative approach, consisting primarily of state education officials, will be used to examine the effects of social class of the student population, poverty level of the state, gender (emphasis on girls), and segregation and discrimination on the school participation and transition of students from the Scheduled Castes and Tribes communities across all levels of education. Similarly, six crucial educational factors that have been anticipated to impact the work of education officers: language as a medium of instruction; teacher shortage and contract teachers; segregation and discrimination in schools; resources; concentrated poverty in schools, and low student attendance, will also be examined. This will help determine the main needs of children from the Scheduled Castes and Tribes communities they serve and the factors that facilitate and hinder their ability to serve these students. The focus will be rural government schools, specifically those managed by the Department of Education, Tribal Welfare Department, Jawahar Navodaya Vidyalaya, and Social Welfare Department with relatively high levels of poverty among their student populations. Data will be collected using two methods: (a) Interview with state education officials who are key decision makers at the elementary (grades I-VIII), secondary (grades IX-X), and higher secondary education (grades XI-XII) level, and (b) review of relevant national and state-level documents

directly related to the research and to supplement interview data. Limitations will be considered when interpreting the study's findings.

Key Words: Education policy, School participation and transition, Marginalized communities, India

Heuristic refinement via models in chemical engineering K12 education

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Abstract

Chemical engineering subjects are considered cognitively demanding, usually steering students into using shortcut techniques during their assessment activities. Although students arrive at correct answers with incorrect heuristic reasoning, the lack of conceptual understanding is a matter of concern to look at. Refining the use of heuristics and the change of heuristic reasoning to analytical reasoning lays the foundations of sound conceptual knowledge in chemical education. To help refine the use of heuristics, I suggest models as scaffolds. Models and representation have been an integral part of chemical education studies to help visualize phenomena, simulate and validate results along with refining wrong conceptual understandings. Using models and representations as a means to study, understand and validate chemical phenomena such as thermodynamics or mass transfer phenomena, students will be able to recognize and decide the appropriate use of heuristics in different contexts. My initial research is directed towards K12 education (after-school STEM education programs) where the students extensively work on hands-on activities and models to validate the experiments and phenomena taught to them at school. K12 students being novices in advanced scientific concepts will encounter many instances where they will extensively use heuristics to solve the activity provided to them. The models provided to the students in their collaborative shared space will help them refine their heuristics as well as provide opportunities for other members to refine theirs. My future work focuses on identifying the type of heuristics 11th-grade students use in their assessments in chemical engineering subjects and how their interaction with models helps them refine and modify those techniques into a more analytical understanding. Literature work related to chemical engineering subjects, modeling and, heuristics has been done. A pilot study on the heat transfer phenomenon for 11th-grade students based on the Columbia space shuttle tragedy is currently being designed.

Key Words – Chemical engineering education, Heuristics, models, K-12 education

Making mechanisms: How academic language mediates the formation of dynamic concepts

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Abstract:

Science learning requires students to transition from their everyday language to academic language (AL), particularly to understand and internalize new mechanisms, which are constituted (brought into being) through new technical terms. Understanding AL requires turning the inert description of the mechanism in the textbook into a manipulable concept in the student mind. This complex process is mediated through teacher narratives, which scaffold the complex concept integration involved in AL, through metaphors, analogies, gestures and other enactive strategies. We present a preliminary analysis of this complex AL learning process, drawing on the embodied simulation theory of language, and classroom data on biology learning.

Key Words – Academic Language, Concept formation, Embodied Simulation Models of Language

Tackling Abstraction through Situated Learning Practices in Introduction to Computational Thinking Skills with RIO

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Abstract- With evolving definitions of Computational Thinking (CT), finding computational potential in everyday life has been one of the roadways leading towards an organic way of introduction to computational thinking skills and practices for learners from diverse contexts. In an attempt to dissect the mechanisms essential for nurturing these skills and practices rather than teaching them through a fixed framework, RIO, i.e., Real-world Internet of things programmable Objects and off the shelf smartphone applications are used in an in-person setting with individual middle school learners, collaboratively with a mentor and in order to understand and unravel the embodied cognitive processes, conducive discourse practices and nature of problems. There will be 3 phases of study. First an exploratory study to evaluate the task environment with RIO will be conducted with convenience sampling Second phase will evaluate the learning of CT skills through RIO activities. The third phase, yet to be finalized, could be a comparative analysis of traditional tools versus RIO The results of study phases will guide the framework for situated activity construction, achieve alignment of profound learning objectives and the desirable behaviours in early stage explorers of CT. The study also aims to clarify the vague concept of 'abstraction' which is amongst the highest cited CT skills and present a pedagogical plan for achieving or detecting abstraction through situated affordance of RIO technologies, the combination of relatively perceivable problems, tools and outcomes.

Key Words – CT: Computational Thinking, CTE: Computational Thinking Education, abstraction, situatedness, real-life problems