Curriculum to Career-*Economy Based Education System through e-Enablement, a revamping of ICT & Teaching-Learning Pedagogy in Secondary Education*

A Concept Note By
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Background:

New Education policy-2020 is emphasizing on 20 different fundamental principles, the important principles which meets 21st century skillsets are:

- Recognizing, identifying, and fostering unique capabilities of each student,
- Emphasis on conceptual understanding
- Creativity and critical thinking encourage logical decision & innovation
- Life skills such as communication, cooperation, teamwork & resilience
- Focus on regular formative assessment for learning rather than summative assessment
- Extensive use of technology in teaching and learning

Similarly, the Industry4.0,the nine components demanding high level skills which are based on strong Science & Math foundation from the younger age, the nine components are:

1. Robots
2. Internet of Things (IoT)
3. Simulation
4. Cybersecurity
5. System Integration
6. Cloud Computing
7. 3D Printing
8. Bigdata (Data science, AI/ML)
9. Augmented Reality

Also, the currentmarket requirements for Skill/ Knowledge are ability to communicate, solve the problems, undertake a teamwork. The present trend in production/service systems areHigh-Level Automation&Flexible Production system.Hence, need to give more focus on **"Higher Order Thinking Skills (HOTS)"** tomeet present day Economic System".

The following two figures are depicting an urgent need of revamping "Teaching-Learning" system:

The exponential development of Information and Communication Technology (ICT) in India during the 90's has made the transfer and exchange of information very fast and easy. This development has put a lot of pressure on the government and the policy makers to utilize ICT for the right usage in order to enhance the accessibility and improve delivery of public services to all the stakeholders in the public verticals of- **Health, Education, Economic Development and Citizen services**. Thus, ICT catalyzed the process of building digital delivery process in the above areas in India.

ICT in Education over the Years:

ICT@School of Phase1 to Phase3 was outsourced programs and loosely connected to curriculum and learning system. The involvement of teachers was largely absent in using ICT into their classroom teaching especially because of the absence of proper content and pedagogical framework. Similar were the EDUSAT and Radioprograms, whichdid not succeed in delivering the intended objective.

Based on theavailable literature and the continuous interaction and discussions with the teacher and students on the ground, there is a felt need of a serious effort to re-design a proper program which will address: "Curriculum-Exam-Incentive" with the help of ICT system.

Has any,really different Strategies and Programs Improved the Quality of Education in Rural Schools?

Both Central and State Education departments have introduced many strategies viz., free books and uniform, ICT program, Mid-Day Meal, creating good drinking water and toilet facilities at school to attract more children to attend the school. But, very little effort has been done to create a more attractive proven model to strengthen teaching-learning - "Attendance-Retention-Performance". The following table reveals the present education standards in Primary & Secondary Education between 2008 and 2018

% of Children in Government School who can Read II level Text, Std V v/s Std VIII

Class	2008	2010	2012	2014	2016	2018
Std V	53.1	50.7	41.7	42.2	41.7	44.2
Std VIII	83.6	82.0	73.4	71.5	70.0	69.0

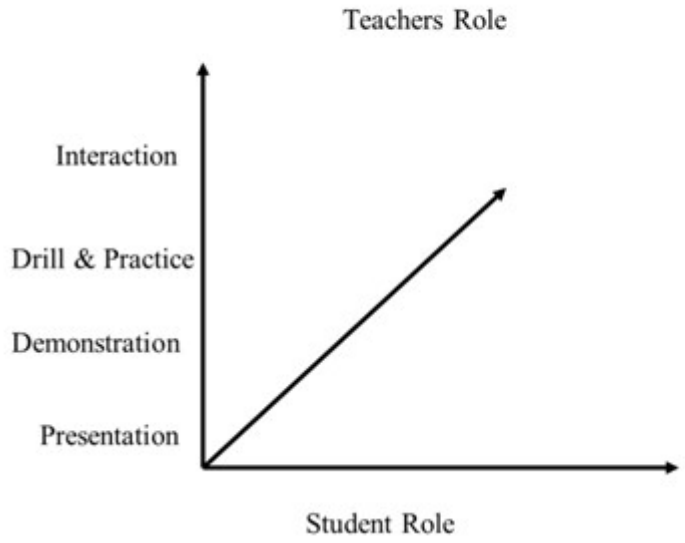
% of Children in Government School who can do Division, Std V v/s Std VIII

Class	2008	2010	2012	2014	2016	2018
Std V	53.1	50.7	41.7	42.2	41.7	44.2
Std VIII	83.6	82.0	73.4	71.5	70.0	69.0

The above tables reveal the poor quality of education being imparted which might attributed to number of problems viz., such as paucity of infrastructure, teacher absenteeism and quality of teaching especially in the rural schools. To improve the quality of education in rural schools, a re-engineered ICT enabled teaching-learning system has been developed. To test this system, we are undertaking the action research experiment which is intended to address the following process of ICT enabled Teaching-Learning System.

Overview of Teaching Learning Curve (Teacher-Student):

Collaborative Eco System of: Teacher-Student Learning Curve



Student competency (in terms of performance in the exam) will increase when a teacher, teaches well with good **"Presentations Skill"** using proper **"Demonstrative Tool"** and Student practices by doing home-work and assignment **("Drill & Practice")** by **"Interaction"** with Teacher. This is an ideal situation of competence building among students.

Does the above Eco System Exist in Rural Schools?
The answer is "Yes" maybe in few cases, "No" maybe in few cases and "Partial" maybe in few cases because of **"Heterogeneity"** of teacher and student across the schools.

How do we overcome the Heterogeneity in Teaching Role?
The action research is aiming to address and improve the quality of education using ICT. The unique characters of ICT are:

1. Through ICT, digital content with audio/visuals can easily be used in teaching and thereby improving the "Retentive Memory of Students".
2. Through ICT, teachers can easily explain complex instructions and ensure students' comprehension.
3. Through ICT, teachers are able to create interactive classes and make the lessons more enjoyable, which could improve student attendance & concentration which will result in good performance

Should the usage of ICT be "Offline" or "Online" Mode to resolve the Reach &Accessibility of Quality Education?

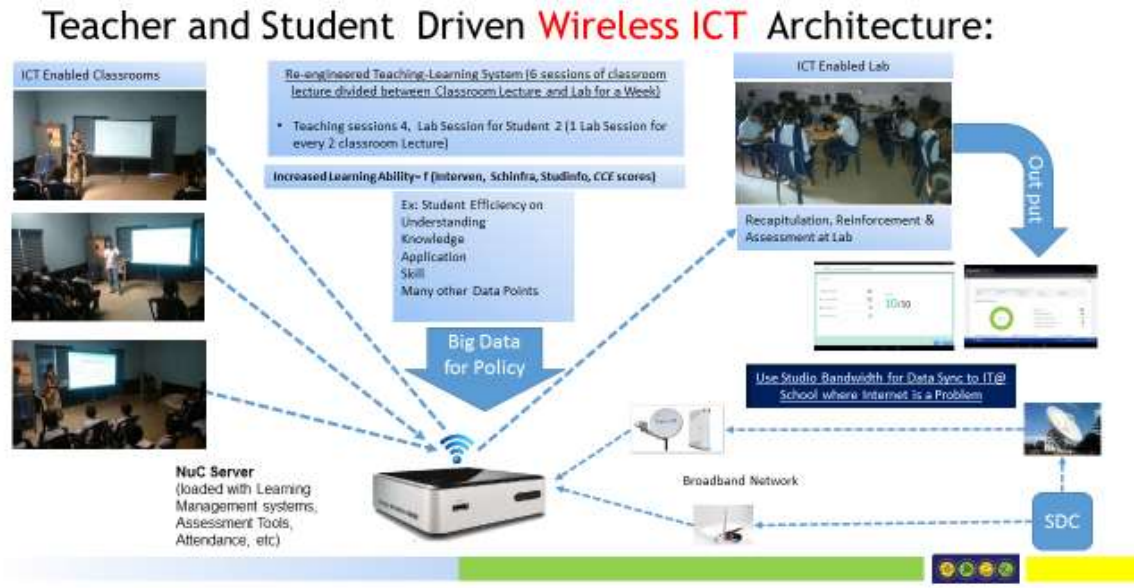
Many Offline ICT interventions were tried out, example, APFs - CALP, ICT Phase 1, 2& 3. Impact analysis reports have indicated the factors for failure as listed - no clarity in Content,

insufficient Training, problem in managing the technology, and Power & Connectivity issues. Similarly with the online EDUSAT program.

In "***Revised Scheme of ICT in Schools XI Plan"***caution has been taken to address all the components of the value-chain of education process using ICT. Hence, the ICT@School project is not only addressing Hardware/Software, but the impact of entire process of ICT in education.

The System Architecture:

Figure-1



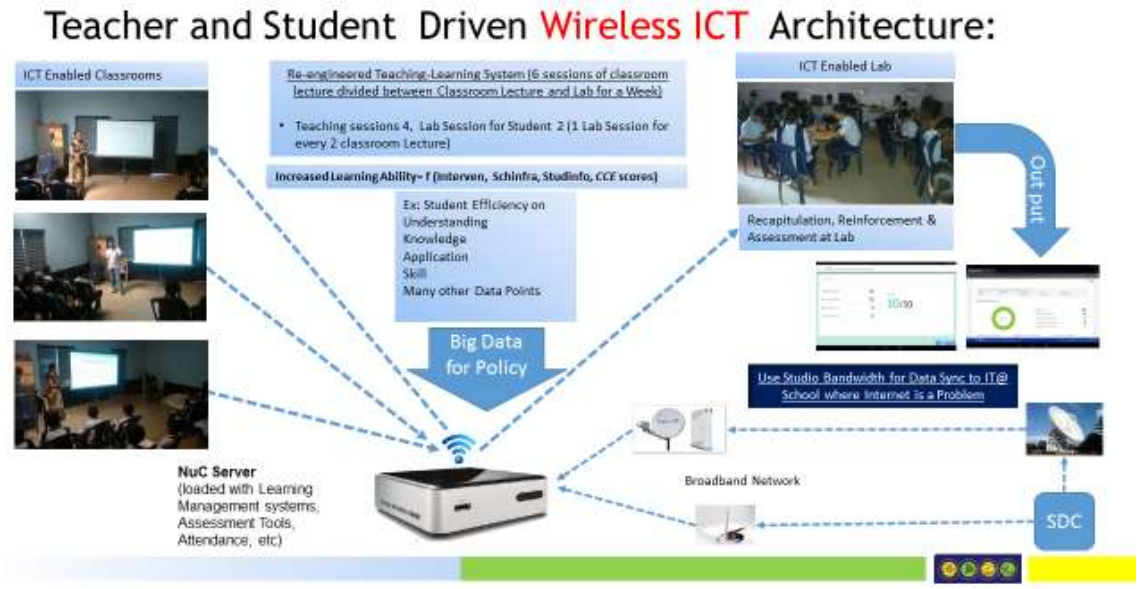


Figure-2

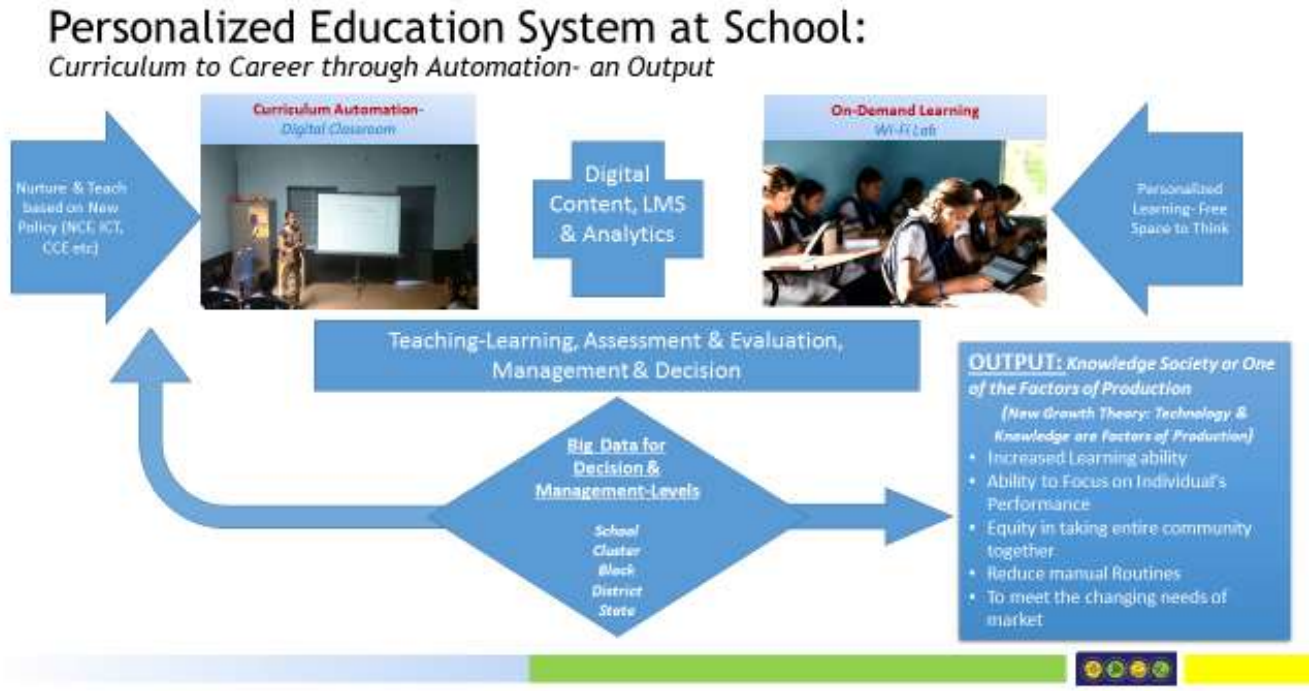
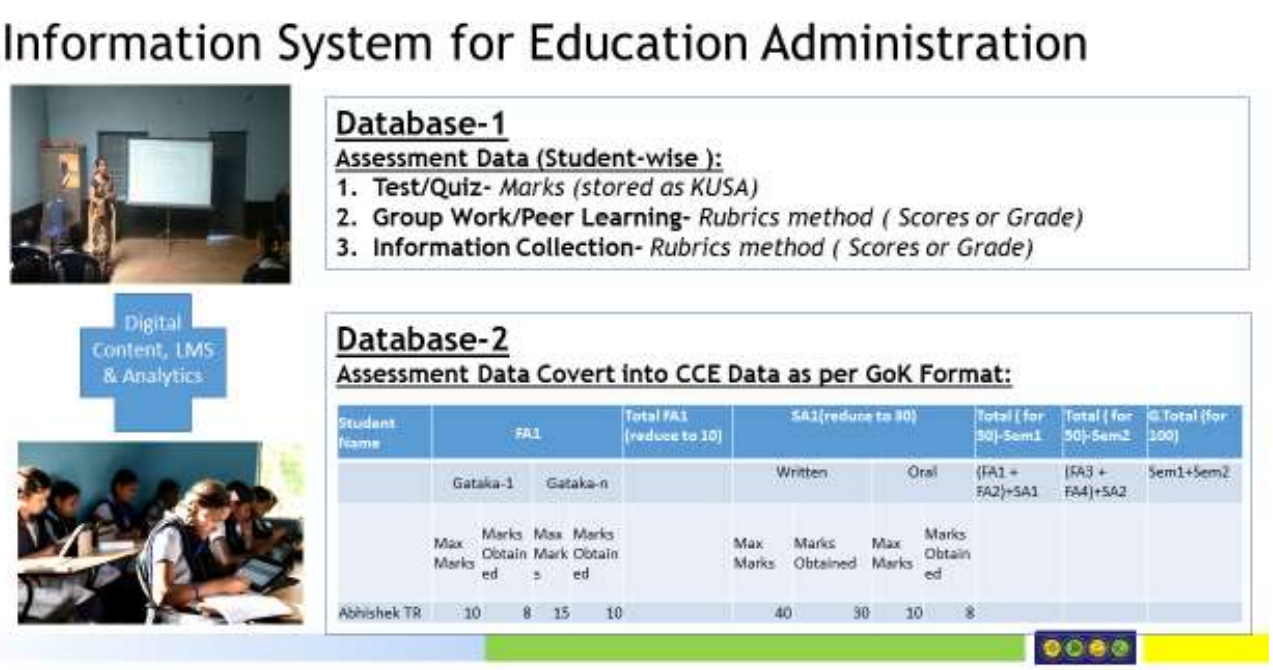


Figure-3



The Process:

Technology: Wireless Micro-Lab Architecture for better technology management as well power-efficient and cost-effective system

Organization:

- Syllabus based Informative & Interactive Type digitised content is made available locally for Teacher & Student
- Train both Teacher & Student on ICT usage skills
- Alter the Teaching-Learning conventional method of 6 class room sessions per week by re-allocating the class room teaching to lab learning ratio of 2:1&2:1 in a week.
- Two sessions classroom teaching from teacher followed by one session of Informative-Interactive type content access and revisit by student at ICT Lab followed by doubt clarification by teacher as well as peer learning the lab.
    - Teacher teaches in classroom with ICT enabled system using informative content
    - Student will again revisit the same classroom sessions (mainly hard spots of the 40 minutes classroom teaching) after every two sessions.
    - After watching the informative & interactive sessions in groups (4 to 5 student for each student node) on the student node (Tab/Laptop/Net top), thestudents are exposed to inbuilt test/quiz.
    - System announces the results and the understanding gaps are identified and re-capitulated by teacher for the better understanding then and there resulting in better learning experience

Eco-system*(Following necessary order: example-timetable, hard spot content teaching using ICT, Many GOs related to use of ICT., Etc.):*

Very little effort has been put till date in measuring the exclusive **"value** "of ICT on a particular sector. New Growth theory (By Romer) and several other studies under *"productivity paradox"* (By Eric Brynjolfsson, SajeevDewan& KL. Kremer) have triedto examine the value of ICT.But results found are mixed or partially explained in the studies conducted in industrial sectors. Similarly, the ICT impact on education, the study byAngrist and Lavy (2002) studied the impact of Computer Aided Instructions (CIA) in Israeli Schools,the author found, though, there was very active use of CAI system for teaching mathematics,but the study results does not reflect in terms of getting higher scores by students. This could be because of the more thrust and focus given towards "Hardware/Software" (?) than the changes needed in organization and eco-system.

Off late, in recent days while building ICT system caution is being taken to re-engineer the process by taking all aspects of "Techno-Orgo-Eco" issues. Accordingly, many research studies use theoretical dimension of Innovation of Diffusion Framework of Rogers (*ex: Relative Advantage, Compatibility and Complexity*) and TOE theory of Tornatzky and Fleischer which addresses "technology" along with "organization" and "eco-system" issues jointly contributing the value for ICT.

Similarly, in "***Revised Scheme of ICT in Schools XI Plan"***caution has been taken to address all the components of the value-chain of education process using ICT. Hence, ICT@Schoolis not only addressing Hardware/Software, but entirely the process of "Teaching Learning" supported by "Technology, Organization Eco-system (TOE)":

1. **Technology** (Technology@School, including animated syllabus based digital content available in local/cloud server accessible through common access point at school)- **(T)**
2. **Organization** (Expert Teachers, Technical & Field Staff, with appropriate skillsets and necessary training)- **(O)**
3. **Eco-system** (Following necessary order: example-timetable, teaching of hard spot content, Many GOs related to use of ICT,etc.)-**(E)**

Research Agenda:

- Identify and Test the appropriate technical tool to enhance Teaching-Learning Standards
- Identify and Test the appropriate Pedagogy to enhance Teaching-Learning standards
- To address the gap in quality of education being provided particularly in rural schools
- Strengthen conceptual understanding and elevate the learning levels of the students in Mathematics and Science.
- Upgrade the capability of the rural students to compete with their urban counterparts with confidence and facilitating their entry into higher studies.

Research Model:

- **Overall Objective:**
    - Attempt to understand how this model of ICT intervention can better contribute to quality education at remote rural schools.
    - To address the gap in quality of education by providing quality education in Government and Government aided schools in rural area by strengthening conceptual understanding and elevate the learning levels of the students in Mathematics and Science.

  To address the above, there is a need of Data for impact analysis:

    - Assessing the schools in terms of Technology Functionality and its effective use (system in place &in working condition)
    - Building Data Structure**:**
        - Student Background Information as per DISE standards*(28 Fields, namely-*

Student Name, Father Name, Mother Name, Social Category, etc)

- Performance: CCE assignments by subject teacher (*FA1- Test, Assignments, Classroom participation, FA2 and SA1, FA3, FA4 and SA2*)
- Pretest & Posttest
- Perception data of Teacher/Students

- **Intervention:**

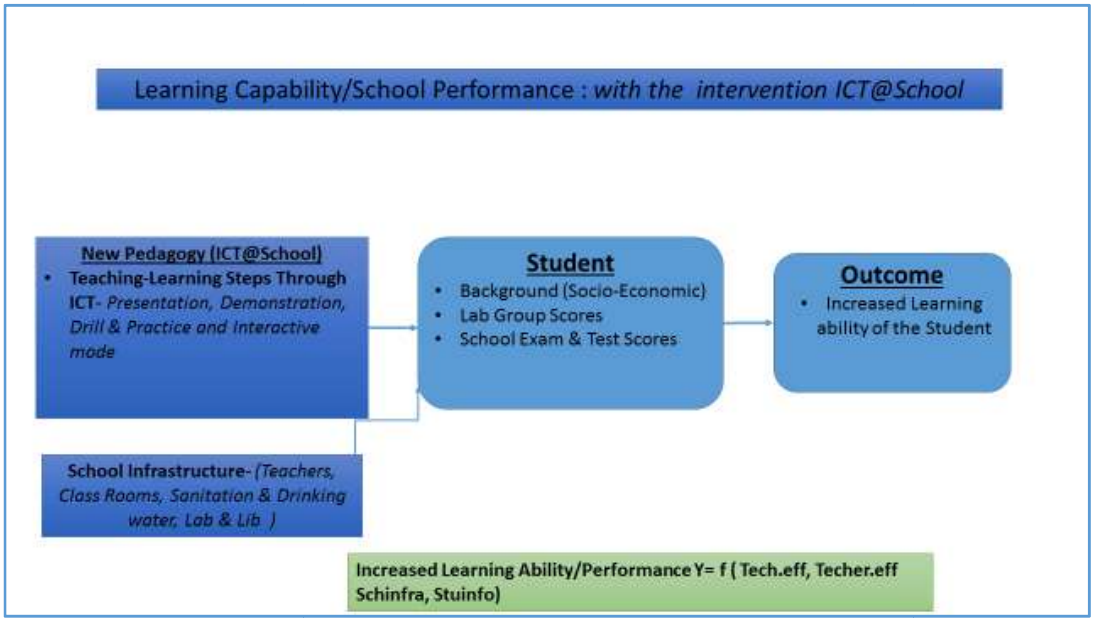
Using ICT@School, analyze how technology, organization and eco-system components can promote improvements in Teaching-Learning curve.

- Content (Informative&Interactive Type - Animated/Video)
- Reach and Delivery (Communication and Computing tool- Satellite/Broadband/HW/SW)
- Teaching (well-trained teachers enabled with ICT tools)

- **Expected Outcomes:**
  - Change in Performance/ Competency: outcome can be measured using, changes in FAs & SAs, Pretest &Posttest using DiD approach
  - Management of Systems (using spatial decision and monitoring model)
  - Pertinence (Applicability)?

Test of Objective with Research Model:

- With the Intervention of ICT, there is an improvement in final exam:
  - *As test scores are increasing from FA1 to FA4, as more and more interactive content enabled teaching for a subject*



Increased Learning Ability/Performance:

Y= f (Interven*, Schinfra*, Studinfo- *background, CCE* scores, test scores)

Model for Test- Difference in Difference- A Regression Model

$\Delta_{Performance}=(Y = \beta0 + \beta1\mathbf{D}^{Post} + \beta2\mathbf{D}^{Tr} + \beta3\mathbf{D}^{Pos}\mathbf{D}^{Tr}+ \varepsilon)$

DID Tabulated Results – Kannada Medium Mathematics $(Y = \beta0 + \beta1\mathbf{D}^{Post} + \beta2\mathbf{D}^{Tr} + \beta3\mathbf{D}^{Pos}\mathbf{D}^{Tr} + \varepsilon)$			
Y	**Semi1 Mean Scores (Pre-Exp)**	**Semi2 Mean Scores (Post-Exp)**	**DiD**
Treatment School-with e-Education	Ytr.sem1= 24.97	Ytr.sem2= 28.25	3.28
Control School-without e-Education	Yc sem1= 28.27	Yc sem2= 28.05	-0.22
DiD	ΔY= -3.3	ΔΔY= Yt-Yc	**3.5**

DID Regression Results – Kannada Medium Mathematics						
	Regression Results			Simulated Regression Results (Assuming 10% Increase)		
Y	D^{Post} =0 (Pre-Exp)	D^{Post} =1 (Post-Exp)	DiD	D^{Post} =0 (Pre-Exp)	D^{Post} =1 (Post-Exp)	DiD
D^{Tr} =0 (Control)	β0= 28.8	β0+β1= 28.1	0.7	β0= 28.8	β0+β1= 28.1	0.7
D^{Tr} =1 (Trearment)	β0+β2= 25	β0+β1+β2+β3= 28.4	-3.3	β0+β2= 25	β0+β1+β2+β3= 31.1	-6.1
DiD			4 (p< 0.173, t=1.37)			6.8(p< 0.024, t=2.29)

Discussion of Results: Mathematics- *Kannada Medium*

- DID Regression – *Treatment and Control School:*
  - Model returns with 3.9939 (p< 0.173, t=1.37) for the interaction

- Though, this value is different from zero and positive, but not to the significant level of $p<0.05$.
- This could be a general phenomena, whenever we introduce a new process/technology, getting

a perfect and immediate fix to the problem is difficult.

- t-test – Treatment and Control School:
  - Is proved in treatment school with a significant change in mean score of 3.28 ($p<.000$)
  - 12.36% increased in Semester2 as compare to Semester1
  - In control school, change in mean score is -0.71 ($p<.335$) and insignificant and change is very

small and -ve

  - This means e-Teaching & Learning system has brought the changes in treatment school in

Semester-2.

  - Treatment school t-test results are highly significant and mean scores are increased to 3.28 ($p<.000$), as we stated, any new intervention may not given immediate results, therefore, more training to teachers to acquaint with new system and motivate the students in coming academic years will improve the scores to "significant level $p<.05$".
  - As, benchmark decision, we have simulated the second semester scores for treatment school at 10%, and we have seen the mean score is increased to 6.8($p< 0.024$, $t=2.29$).
  - Therefore, school authorities to ensure to reach the significant level by giving more inputs to teachers and students.
- However, one can conclude, based on t-test and tabulated scores of DiD model, this experiment made a significant change in learning outcomes of the students.

The Budget to Implement in Government Higher Secondary schools:

Sl.No	Activates	Funds in Rs