Position Paper from the Roundtable Discussion
on

Enablers, Barriers, and Opportunities for Adoption of Technology in Telangana Government Education System

Organized by IIIT Hyderabad on 22nd November, 2022

Context

The Raj Reddy Center for Technology and Society (RCTS), IIIT Hyderabad, organized a closed-door brainstorming roundtable meeting on "Artificial Intelligence in Telangana Government Education System". The objective of this meeting was to build a picture of the current state of data capture, digitization, data analytics, and software tools used in the state education system; from relevant end users and key collaborators such as teachers, headmasters, school complex heads, Mandal Education Officers (MEOs), District Education Officers (DEOs), Government department liaisons, and grassroots Non-Governmental Organizations (NGOs).

The meeting tabled the practices, issues, and drawbacks in the existing data collection, data maintenance process, and software solutions. It also explored what other data needs to be digitized and what other solutions are to be developed to fully utilize the digitized information and where Artificial Intelligence (AI) or Machine Learning (ML) systems can have the most impact while grounding the process in reality by tabling the expected hurdles for field deployment and acceptance of developed solutions.

The following three majors areas were discussed:

a) *Current state of the use of technology in the Telangana government education system.*
b) *Possibilities for digitization of data in the government education system.*
c) *Opportunities for AI-based solutions to support administration and learning.*

A. Current State of the Use of Technology in the Telangana Government Education System

The Telangana government has been investing large efforts towards the digitization of various aspects of the education system in the state over the past couple of years. This has involved the development of various software and custom applications for functional tasks (teaching, digitization, and administration), the creation of digital educational content, and the supply of technology assets and infrastructure through various programs. These efforts have also been concurrently supported in some localities by NGOs and other private entities. The aim of the various investments has been to digitize and streamline education in the state and provide students with the most optimal learning resources possible.

This ongoing effort has been a commendable one, however as with any large technology transition, this has not been without its own hurdles. To provide a better context of the current scenario in the field of government education system in the state, below is a list of technologies and software currently in use, some of their advantages, drawbacks, and loopholes as gathered from the attendees of the roundtable, who have first-hand experience with the various systems in play.

***Technologies in use and resources available*:**

- Multiple software modules have been generated for various administrative tasks such as attendance entry, mid-day meal tracking, grade tracking, etc., collectively intended to perform the function of an Integrated School Information System.
- Applications such as Excel, Google Sheets, Google Drive, Dropbox, etc. are acting as the primary platforms where teachers and administrators are performing their day-to-day work and collaborations. And have greatly sped up their workflows in many cases.
- A large extent of the work communications has been using Gmail, with a noted transition to WhatsApp in recent years.
- Technology resources are being made available with smartphones being supplied to high school students through smart tablets and computers provided through various other support programs, NGO intervention programs, etc.
- T-Fiber connections are being and have been laid out to most government schools at a district level, to allow for stable internet connectivity.

The technologies and software above cover both those developed by the government and those available in the open market that are being utilized at various levels in the state education department (students, teachers, administrators, etc.)

The above list is not expansive and other tools and resources may be available and utilized by the different parties involved.

***Drawbacks and loopholes in the current technology solutions being used*:**

The drawbacks in the current systems can be classified into three main categories:

1. **Infrastructural issues:**
   These issues can be further subdivided into the following two types:

   a. *Hardware and software resources:*
      - Computer labs in many schools are old and deprecated but are not replaced due to the systems being on the government list of supplied school resources and newer systems are only provided when the school does not already have any systems. But these existing systems are not properly maintained with regular software updates.

- Hardware procurement is also not standardized, especially those through support programs of different NGOs.
- Software modules developed for the singular purpose that have outlived their use or, for which the intended functionality may already be covered by a newer module are still being annually paid for in some cases.
- The various systems and software modules deployed are also not regularly updated in a timely fashion, leading to system crashes, data loss, and workflow interferences.
- The T-Fiber lines have been laid out to connect many schools to the internet, but other equipment to make use of the connectivity has not been made available or is not in a usable state in many schools.
- The above leads to a high dependency on mobile data for connectivity both from the perspective of students and teachers/administrators which leads to poor adoption of any technology initiatives in rural areas, where signal strength and coverage issues persist.

b. *Manpower*:

- No dedicated IT team at the government level to handle the education department's technological needs. They have been added to the long list of departments being catered to by the already burdened E-District Manager who maintains all government IT systems.
- No dedicated on-campus trained faculty or IT personnel to maintain the computer labs and any other technological solutions deployed at the schools.
- Response times for off-site support technicians is very erratic with issues being left unsolved in many cases.
- Lack of dedicated personnel for the digitization efforts in areas such as digitizing old records, or for catering to increasing non-teaching administrative tasks such as addressing data and report requests (most on very short and abrupt deadlines), is distracting teachers from the primary function of educating students.

2. Technology issues:

These can also be classified into the following two types:

a. Design, development, and deployment of technology solutions

- Software modules are being designed on an at-requirement basis with little attention paid to compatibility or data redundancy with already existing applications.
- The lack of consistent development teams adds to the above redundancy problem, with newer teams not always fully aware of the information and feature set of existing applications.
- Multiple applications are being developed for teachers and administrators to use with no centralized user authentication/login and data storage. Leading to very poor workflows in performing day-to-day tasks.

- The above is compounded by poor data practices such as:
  - No data entry checks or synchronization across platforms and different departments.
  - Cumbersome workflows, with large numbers of redundant data entries, lead to increased user fatigue and data entry errors.
- There is also a lack in attention paid to the ease of use of developed systems, by the notable lack of assistive features such as auto-form entry with pre-existing content, bulk data entry, and editing, mid-operation state saving to prevent loss of work, etc.

b. *Lifecycle Planning:*
- Bugs in deployed systems and software are not followed up with, making them unusable and unsafe in many cases.
- The use of data flow after collection has not been thought through, with data collected not being stored properly or effectively processed and utilized.
- The little data analytics and reporting that is generated is not in an easily digestible format (e.g., headmasters sending screenshots of their attendance reports to the MEOs), severely limiting the communicability of the data.
- The above communication is also predominantly one-way with teachers collecting data and reporting to higher authorities in the chain, with data aggregated at subsequent levels (teachers >> Headmasters >> MEOs >> DEOs), but barely any analytical insights at a larger context being fed back to the teachers.
- Long-term milestones have not been established for assessing the state, usefulness, and effectiveness of the various technology solutions and iteratively improving upon them based on planned road maps, user feedback, and current situations.

3. **Lack of awareness of technology tools and their perceived value:**
The technical and manpower issues listed above are also compounded due to issues in the awareness and perception of the populace to the various technology and digitization initiatives. Here, the issues arise in three main ways:
   a. Lack of clear communication on all the sets of available tools, the longer-term impact of a fully digitized workflow, along with the lack of downward communication of any insights that may have been derived from already digitized data, greatly diminish the presence of any positive incentive for adoption of the new technologies by the on-ground personnel.
   b. Shortage of training in fully utilizing the software and technologies, along with minimal to no end-user input taken during development, alienating the end users' interests and concerns from any new systems developed.
   c. Lack of support documentation and user guides, to assist the end users to be able to learn about the various tools, debug issues, and explore better ways to integrate these digital tools into their daily workflows.

B. Possibilities for Digitization of Data in Government Education System

With the large governmental push towards the digitization of data in the field of education, student grades, student attendance, and teacher attendance is being digitized in some fashion or another. Information such as "*Unified District Information System for Education*" (UDISE) codes for schools, information regarding mid-day meal programs, and other such support programs are also being digitized.

The processes involved in these digitization efforts may not be optimal as already stated previously, but does provide a good start. Moving forward, the following set of data are what were considered by the panel as items important to be digitized in a not strict descending order of priority, based on their relevance to track the student performance throughout his/her journey in the government education system;

1. *Creation of a Centralized Education Registry and Integrated School Information System*:
   As pointed out earlier, a major issue affecting the effective use of the existing software and tools is the lack of a centralized database that the different systems can access information from. Hence this would be a great place to start solving the various issues involved, without having to throw out all the developmental efforts carried out to date. It would serve the following purposes:
   a. Creation/Use of a unique identifier code to better track every user's information (students, teachers, and administrators), like the UDISE code for schools. These user codes need not be created from scratch and could possibly utilize existing identifiers such as an Aadhaar number.
   b. Reduce some of the repeated data entry operations required to work with multiple software solutions.
   c. Increase the reliability of data storage by enabling centralized monitoring and control.
   d. Enable us to understand better why a given tool is not being used to the expected extent beyond the issues of redundant data entry, enabling better functionality design for future systems.
   e. And most importantly give us time to develop a more functional and unified system by making the existing systems more useful to the users in the interim while continuing the digitization process and improving the perception of end users to the use of digital tools in their day-to-day workflow.

2. *Student Registration Information and Transfer Certificates (TC)*:
   This information is currently digitized to a certain extent, but the process is not strictly digital, leading to gaps in information. To address this, two steps must be carried out:
   a. Any new student registration and TC generation must be performed in a digital fashion where possible.
   b. Historic student registration and TC records must be digitized, both to allow ease of access and to prevent loss of data due to degradation of the physical records.

3. *Student Performance Profiles and Reports* :
   As stated before, student grades and attendance are being digitized. But efforts are required to:
   a. Create student profiles to track students learning and progress across multiple years
   b. Digitize historic grade and attendance records.
   c. Digitize examination information and performance reporting, beyond just grades and test scores using informative digital holistic progress cards.

   This would enable teachers to better understand their students' development throughout their schooling, beyond just their own personal interaction with them. And enable them to compare the development of multiple students, to better understand their students' performance from a larger context.

4. *Content Digitization*:
   Efforts in this aspect would have to be in the following two forms:
   a. Onboard existing textbooks, study materials, question & answer banks, etc. (which are already available in a digital format for the most part), onto online learning platforms.
   b. Creation of new digital learning content in the form of audio/video lectures, tailored content to better perform formative and summative assessments for different learning levels, virtual labs, learning games, etc.

   This would ease digital learning and grading while providing teachers and students more access to learning material that can be customized based on their respective needs.

5. Infrastructure availability and usage
   Information on the availability, state, and usage of various infrastructure resources could be tracked and stored digitally on a periodical basis.

C. Opportunities for Artificial Intelligence-Based Solutions to Support Administration and Learning

Based on the responses from the panel for all three focus areas, the possible solutions can be categorized into three levels (low, medium, and high), based on the complexity of solution design and implementation. Once more, the solutions below are not an extensive list of all possible solutions and are not fully formulated. They are simply items of interest that require flushing out and are to be built upon, to address some of the issues or requirements raised during the roundtable.

1. *Low complexity*:
   These are solutions that require no major hardware/infrastructural investments or manpower deployments. They would build upon existing resources for the most part and act as stop gaps or building blocks to longer term AI-based solutions.
   a. Standardized pivot tables for use with Google Sheets or Excel, to provide quick analytics on the data collected and quicken the workflow for regular reports.
   b. Downward communication of analytical insights (even if done sparsely across the calendar year), would give a positive incentive and motivation for the teachers to perform their roles in data collection and aggregation.
   c. Dedicated centralized systems for user information, billing, and data storage, for the Telangana Government of Education, allowing more control and streamlining of information available across the multiple existing platforms. The centralized billing would also ease tracking of scale government-supported programs towards education in the state.
   d. Automated data validity checks during data entry on all systems.
   e. Digital authorization and remote work portals for the government educational administrators/officers, to allow them to work from multiple locations, increasing productivity and availability.

2. *Medium complexity*:
   a. Standardization of reports and data formats across different platforms and government departments (at least in relation to education data and reporting).
   b. Standardized workflows for periodic data validity checks and student record updates.
   c. Automated generation of personalized student performance reports, and customized task and data reporting for teachers.
   d. Informative dashboards for quick summarization and visualization of information to the users, to allow for auditing and intervention planning.
   e. Highlighting students, teachers, and schools in need of intervention based on various set criteria (be it performance, attendance, infrastructural requirements, etc.)
   f. Development of a learning recommendation engine to suggest learning paths based on student historical performance.
   g. Automated performance rewards for teachers through preset criteria, removing manual intervention from the process.

3. *High complexity*:
   a. Digitization tools to scan older records.
   b. Building of various Indian language corpora and machine translation engines, to allow for easy processing of historic records and increased user accessibility.
   c. Automated attendance systems for tracking participation in school and government support programs using student/teacher biometrics.
   d. Automated assessment of student attention and performance using computer vision-based systems.
   e. *Multi-language Support:* Given the richness of languages in India, allowing integrated multi-language support using prepopulated language corpora and inbuilt

machine translation engines, may act as an important requirement for the widespread use and compatibility of any systems developed. This feature would also play an important role in user convenience, especially in the case of digitizing historic records which may be in different languages as well as making digital education content available in the native tongue of the user.

Closing Remarks

The complexity of the above solutions may be in terms of their design, implementation, data requirements (in case of ML models training), deployment (hardware, manpower requirements, adoption, etc.) The solutions above cater to being ML/AI-based or data-based. Purely infrastructural solutions or the infrastructural, manpower, and awareness requirements for implementing any of the above-listed solutions have not been discussed here.

However, below are a few key points that would be good to keep in mind as we move forward to try and solve any of the issues we have discussed in the current position paper:

- Explore opportunities to stabilize and standardize any developed applications or platforms
- Any digital tools and supportive hardware must at least be supplied at a School Complex level to the Complex Resource Person (CRP), to enable for effective reach of the solutions.
- Outreach and training programs also need to be planned in conjunction with any new solutions developed, to better equip the end users (students, teachers, and administrators) in using the technology-based solutions.
- Design solutions that fully utilize already available technical resources while avoiding shoehorning needlessly complicated solutions to simple issues.
- Give priority to physical interaction for teaching.
- Keep the end user in mind and involve their feedback in the development process.
- Finally, proceed with gradual pilots to allow for catching issues at an earlier stage and avoid failures from causing large-scale disruptions.

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Panelists:
We greatly appreciate the time and insights from our panelists:

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About

Raj Reddy Center for Technology and Society (RCTS) is an initiative of IIITH to enable research and emerging technology-led solutions for grassroots education and public health, with a specific emphasis on rural areas. It will identify a few socially relevant themes and take up projects in them to create a sequentially linked amplification of impact. It will take a wholesome view of the problem addressing all aspects, technology and otherwise, through to realizing value on the ground. Sustainability and Scalability are the key concerns in all engagements at the Center. It aspires to be a global hub to bring the latest research to solve societal problems.