

Smart Card for Learner Management System in ODL

Dr. K. Sasicoumar Brumot¹ and Dr. E. Krishna Rao²

¹Assistant Director (Sr. Scale), IGNOU Regional Centre, IGNOU Regional Centre, 'Gyan Vatika', 14, Hindustan Colony, Amravati Road, Nagpur

²Regional Director (i/c), 2nd and 3rd Floor, Kappeesh Building, M. G. Road, Opp to Mulund Rly. Station, Mulund (West), Mumbai

ABSTRACT

Technology and ICT have become a part and parcel of the Open and Distance Education System not only in India but also across the globe. The academic transaction is predominantly by using technology in which both the learner and the teacher has to accustom to the use of technology. The Learner management system irrespective of the mode of transaction can be backed up by technology for single window operation. India, even though is a developing nation, have contributed to the human resources for digitalisation in various firms across the globe. With the Government initiatives to make paperless environment, the ODL has to think in line with Digital Mapping of Learners and how they Utilise resource like being present in the counselling session, submission of assignments, remittance of fee, registering for examination. The need for consolidating mapping of learners for a Distance Teaching Institution (DTI) is necessary as each section of activity takes place in isolation from the other. For example, the date for examination is displayed without checking of whether the study material has reached the learner. In addition, the learners are widespread geographically making it difficult to insist upon their physical presence in a place of choice of DTI to assess their progression in the study. Constant need for Innovations for managing learners to improve the quality and provision of better support services has been felt due to the widespread of scattered data at dislocated places. Digitalisation of information by means of chip not only consolidates scattered data but also provides avenue for information retrieval on demand either by the learner or by the institution. With the need envisaged to embed information related to learners in a digital form, the smart card seems to be one of the solutions. In India, Smart Card has made an impact in financial transactions and its potential has not yet been explored for academic transaction. This paper proposes of how data integration in Indian Context can be done by smart card so that the management of the learner is specific to the need and purpose. The paper also enumerates the various accessories necessary for utilisation of the smart card. The paper also discusses about the advantages and disadvantages of using the smart card and the provisions for improved services over the manual maintenance of learner information.

Keywords: ODL, Smart Card, LMS, paperless environment, digitalisation

1. INTRODUCTION

Smart card is a plastic card embedded with microprocessor chip, which stores clientele information and transact the information to a computing system via a card reader. Smart card has been widely used throughout many sectors including banking, healthcare, entertainment and manufacturing. The idea of smart card is widely used in different educational sector for multipurpose reasons.

In Educational sectors, many universities initiate smart card technology as multi-application card. A multi-application card is a Smart Card which has a provision of using multiple sorts of applications on the card itself thus lessening the number of cards in the wallet. Educators at all levels are seeking ways to leverage technology to do better services by simplify administrative tasks, and managing learners information.

According to Mitra et al. (2004), the University sector is one important field which has been active in pursuing multifunctional cards because of the number of factors involved in managing students life i.e. student ID, gaining access to security doors, photocopying etc. - combining several functions in one single

multifunctional student ID card provides a vast mitigation in handling effort instead of bringing separate cards for each function. So it means that smart cards are gaining importance in students' daily life in the educational sector.

It clearly shows that the main function of educational institution is to provide service in line with its core mandate, which includes teaching, training, learning, research and development to students. To execute and manage all these tasks effectively, Learner Management System (LMS) helps us. With the LMS it is easy to retrieve records at any point in time and be reliable at all times. Thus, in the present paper an attempt has been made to discuss about the smart card and the application of integrated embedded system in Distance Teaching Institution (DTI) called learner Management system (LMS).

The Learner Management System is similar to Learning Management System with a holistic approach (embedded with Academic, Administrative, Financial and student Support Services) is proposed in this paper. According to Ellis, Ryann K. (2009), Learning Management System is a software application for the administration, documentation, tracking, reporting and delivery of educational courses or training programmes. In this paper, it is proposed that Learning Management System substituted with Learner Management System by embedding multi-applications (Server Component and Interface) relevant to Distance Teaching Institutions (DTI). Today, the infrastructure for the smart card based system is probably best represented by the Internet. Further, infrastructure comprised of many platforms and their network connections through which specific elements of smart card based systems can be interconnected.

The paper discourse an overview of Smart Card and its application related to education and considers why it is important in the digitalised world. Further, the paper throws lights on the future research in smart card and its application in the DTI.

2. RELEVANT TERMS AND LITERATURE REVIEW

2.1 What is Smart Card

"A smart card is a plastic card about the size of a credit card, with an embedded microchip that can be loaded with data, used for telephone calling, electronic cash payments, and other applications, and then periodically refreshed for additional use." (Merckling and Anderson, 1994; Whinston and Choi 2004).

2.1.1. Learning Management System

Learning Management System is the software that automates the administration and delivery of learning.

2.1.2. Open and Distance Learning

ODL refers to a system of teaching and learning characterized by separation of teacher and learner in time and/or place; uses multiple media for delivery of instruction; involves two-way communication and occasional face-to-face meeting for tutorials and learner-learner interaction (Commonwealth of Learning, 2005).

"a form of education in which there is normally a separation between teacher and learner and thus one in which other means – the printed and written word, the telephone, computer conferencing or teleconferencing, for example – are used to bridge the physical gap." (Mugridge 1991)

2.1.3. Distance Teaching Institution (DTI)

Educational institutions which resort to distance mode of teaching to transact the academic curriculum are referred to as Distance Teaching Institution. In a Distance Teaching Institution (DTI), the learner is away from the Educational institution and peers. Flexibility exists in a DTI for the learner to couple studies along with the work/social/personal commitments.

2.1.4. Learning Management Systems

Learning Management Systems is a software application or Web-based technology used to plan, implement, and access a specific learning process.

2.1.5. Open and Distance Learning

Students and instructors are separated by time, location, or both in this model of instruction.

2.2. Literature Review

The review of literature related to prevalence of Smart Card is discussed under the following sections:

2.2.1. Origin of Smart Card

Smart Card as such has been used in many sectors ranging from Governance, banking, Health care, hospitality industry, and customer services. All the sectors use the smart card to track and identify the authenticated customer/clientele who initiated the first necessity for this smart card. Whinston and Choi (2004) have documented 'using smart card for soldier's dog-tags, store electronic money, form of token in banking Systems, petrol companies which you collect to exchange for free gifts at a later date and used to store hospital patients' medical records so that they are always instantly accessible and easier to carry around'.

2.2.2. Smart card Technology

Smart card technology has been around for more than 30 years. Since its first introduction into the market, smart card was used for the payphone system. As card manufacturing cost decreases, smart card usage has expanded to other industries including manufacturing, telecommunications, retail and banking (Casset and Lanet, 2002)

Rinaldo Di Giorgio (1995) opines that 'Currently student cards are implemented with either magnetic strip or ordinary plastic cards which have very limited or no space to store data and most have one use i.e., as an identification card. Smart cards have a great advantage over magnetic strip cards in space, security, reliability and functionality'.

The information can be accessed by a card reader into where the card is inserted. The information may include access codes for authentication, account numbers including merchant and banking account numbers, and electronic cash." (Farrow, 2002).

Technology plays a major role to develop smart cards. According to Burn et al., (1997, p.354) "the introduction of smartcards can enable developing economics to leapfrog stages of economic development and rapidly acquire an IT infrastructure with vast access to information".

2.2.2. Smart card and its application

Malar and Sivalingam (2009) have documented in usage of Smart card application for e-campus services in Identification Card, Library System, Staff attendance System, Medical System, banking transactions, Access Control System, Time Attendance System and Parking Management System in conventional educational set-up.

Currently, smart cards are being widely used for higher security in terms of building access control, logical access to computer system or applications and two factor authentications for online transactions (Whinston and Choi 2004).

3. HARDWARE AND SOFTWARE REQUIRED TO ENABLE SMART CARD

Minimum Requirement of Hardware and software to Enable Smart Card

8051 Microcontroller: This 8051 microcontroller comprises of 40 pins based on the Harvard architecture in which both data and program memory are entirely different. This microcontroller can be used in different systems because it gets easily integrated in any sort of project.

Power Supply Block: This power supply block comprises of a voltage regulator, bridge rectifier circuit and a step-down transformer. Single-phase Active Current power supply from the mains is step-down to a lower range of voltage which is again rectified to Direct Current (DC) by using a bridge rectifier circuit. This rectified DC current is filtered and regulated to the entire circuit operating range with a voltage regulator and capacitor, respectively.

LCD Display: Most of the electronics projects make use of liquid crystal display for displaying the status and information of the employees and students to access a secure area. There are different types of displays used in projects like LED and seven segment displays. Selection of display depends on the following parameters: ambient lighting conditions, power consumptions and cost of displays.

Smart Card Readers: These smart card readers are used as terminals to read the information stored in the smart card. It can be interfaced with a computer or 8051 microcontroller with the help of level shifter.

Level Shifter (MAX 232): In order to provide the communication between the smart card reader and 8051 microcontroller MAX 232 is used. This level shifter provides a standard serial binary data interconnection unit between data communication unit and data terminal. RS232 level signals from the smart card reader are converted into TTL level signals of 8051 microcontroller by this unit.

Relay Driver: This project uses a ULN 2003 relay used to drive high current Darlington transistor array and high voltage. These relays are used for switching of the loads in the project with the help of relay driver.

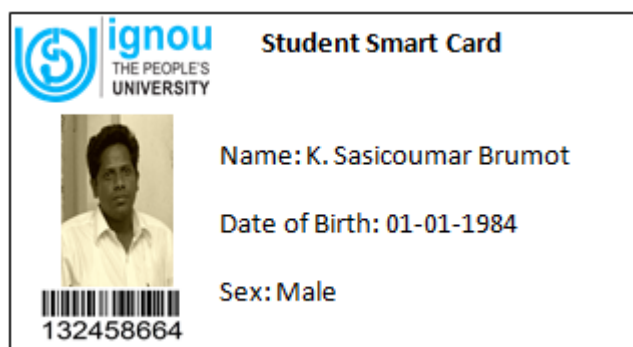
3.1 Software Components

Software tools like Embedded C language, Keil Compiler, are used in this project for programming the 8051 microcontroller.

4. TYPES OF SMART CARD

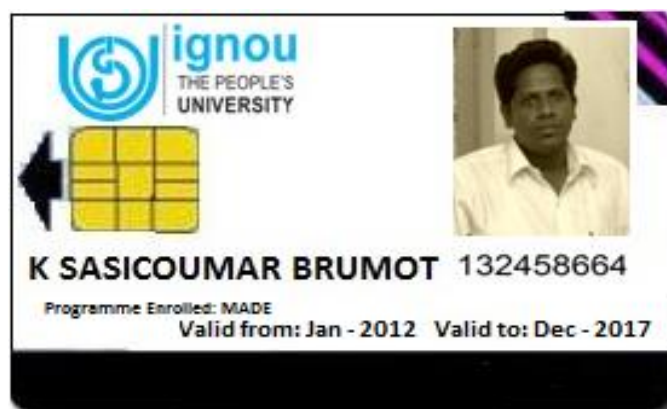
4.1 Barcode Based card

A barcode is an optical, machine-readable, representation of data; the data usually describes something about the object that carries the barcode



4.2 Chip based Smart Card

A chip card is a plastic card that has a computer chip implanted into it that enables the card to perform certain functions. These could include financial transactions, security system access, and storage of medical or other records.



5. SMART CARD IN CAMPUS ENVIRONMENT

With the advancement in technology and the tools available in the market Smart card is the most used technology that has been adopted in the universities, College and also now in Schools. These smart cards in the campus are used for multipurpose. Right from admission to Certification these smart cards paves a way for tracking the learner and his activities with respect to the course contents and the Counselling schedules.

In some campus Smart Cards are used even as e-wallet which restricts the money based transactions and encourage Governments visions of Moneyless Transactions

Since Smart card is one the technology, and we can see many universities in Developed countries are utilising to the maximum.

If we get into the closer look some of the below universities and campus are using the technology

1. Stanford University
2. Yale University
3. Harvard University
4. TUM- Technical University of Munich

These universities use the Smart Card to the Maximum and new innovative approach has been incorporated to access and ease the process related to learning and Development and also paves smooth transactions based on Learner Management System.

Applications Incorporated through Smart Card system

- Attendance system
- Library system
- Door access
- E -Wallets

Following are some of the advantages on using the Smart card feedback provided by some institutions

- Safe to transport
- Data storage capacity increases
- More flexible
- Prevents Fraud
- Security
- Reusable
- Control over cash payment and administration
- A chip operating system that supports various applications
- Longer expected life span and highly durable
- Easy to use without need of connection via telephone or online

In India, IGNOU (an Open University with National Jurisdiction/PAN INDIA) is the only Distance Teaching Institution has made an attempt to issue smart card to the students in place of conventional simple identity cards as a pilot project. However, continuity of usage across was not been documented. Thus, in the present, paper an attempt has been made to understand the adoptability of Smart card and its interface in Learner Management System.

6. CURRENT SET UP IN DISTANCE TEACHING INSTITUTION

The Open and Distance Education (ODE) System is catering to 25% of the total students registered for higher education in the Indian Sub-continent. This share is increasing year after year keeping in view the limited recourses with the conventional education system. Both developed and developing countries consider distance education as a new approach is capable of providing knowledge to those learners who have not been served by the traditional class room setting. Distance learning has become an accepted and indispensable part of education in most of the countries. Distance education institution are started to trim their expenditure with the support of Information and Communication technology. A new method of distance education viz., technology mediated distance education has emerged (Jane & Hackley, 1997).

The media used so far in distance education (eg., print, radio and television, audio and video) are now supplemented by networked computers. Now, more and more courses are already moved to Virtual classrooms.

Even after lot of Technological changes emerged in the Distance Teaching Institutions, still Student admission is a manual and time-consuming process at the majority of Universities. DTI have adopted online admissions but students still must stop by the main office and stand in line to pick up their identification cards. Inefficiencies in manual processes of ID card extend minimum three weeks to reach the learners. Student tardiness is an ongoing issue even it is shared by fresher's many times in the induction meetings. Students must stop by the office to pick up their handwritten tardy ID cards by taking permission/leave from their employer. To avoid these issues the smart card access will give optimal solution for streamlining administrative tasks. Further, following are the Feedback on existing System:

1. Geographical Terrain: With Pan India presence, and multiple stakeholders for the same process, leads to incorrect implement and execution of varied course and academic perspectives.
2. Id card Issues: Manual Process takes three to four weeks to generate the ID card and delivering the same. These involved lot of Manual work, Cost involved in Delivery, Time Reluctant during the process. As this process takes more time, the first semester/year starts little late.
3. Financial Transactions: Submission of DD and processing the same at DTI are time taking process, by which university lost its interest. Sometimes, the validity period (3 months) of the DD will be expired in the processing time and getting it back after re-validation will take minimum 4-5 months. In this process, the Institutions are lose it interest.
4. Attendance tracking: Due to manual intervention of Attendance recording, the tracking of Attendance becoming cumbersome and lot of wrong claims are in place.
5. Absolute Planning & Budgeting: Planning and Budgeting made based on the current Manual data of Regional centre seems to be ineffective as the data are corrupted/underutilised

7. ANALYSIS OF SMART CARD IN DTI**7.1. Advantages of Smart card**

In a DTI, there are two spheres which are mutually exclusive but are interdependent. They are the Academic Activities and the financial activities. The Academic Activities depicts the flow of the student life cycle as, many a time, the fulfilment of the Academic Activities by the learner makes the access into the programme to culminate in success for the learner.

The Financial activities of receiving the grant, disbursing the grants and booking the expenditure under the respective heads helps to know the expenditure involved for the social cause of education. However, the receipts of revenue even though mainly from student enrolment, at times is also generated from selling old newspaper/rathi etc., It is pertinent to mention that irrespective of the activity (academic or financial), the smart card works on information already stored linking it with information being stored and facilitating to arrive at information needed on demand.

The Advantages of using the proposed Smart Card in DTI are given below:

7.2. Academic Activity in Student life cycle management

7.2.1. To track Student movement

- Minimized administrative paperwork through real-time access
- Record of student visit to Regional Centre
- Record of student visit to LSC for academic transactions
- Record of student visit to LSC for peer interaction
- Record of student visit to LSC for interaction with Academic counsellor

(Student movement and purpose is recorded)

7.2.2. Point of access for student

- Data automated functionality for students (point of access initiated dialogue by student mediated interaction by self-service portal access – no need of any external assistance)
- Automated and synchronized student life cycle, from being an applicant to a student upto certification.
- Register for Introductory meeting to poll for convenient day
- Marking the presence or absence for a counselling session scheduled.
- Time limit linked activities and the prescribed fee to be paid.
- Reminder for deadline to be met
- Reminder for compulsory component Academic Activities

7.2.3 Point of access for LSC

- Movement of learner and academic counsellor (attendance)
- Enhanced personalisation of service to students and staff via LSC portal access – validating student movement (coupled with reminders for not visiting) and fulfilment of pre-requisite by student.
- Marking the presence or absence for a counselling session scheduled and informing the academic counsellor about the probability of thin or thick attendance.
- Increased security over sensitive student records with objectivity of purpose.
- Improved individualised advisory services through consolidation of real-time student data, thereby targeting to improve student retention and performances.
- Identification of bottlenecks (inability to comply with deadlines for assignment submission, missed deadlines, late fulfilment of deadlines, fear, life skill management, help desk access hesitation)
- Identification of slow learners
- Identification of learners with special need/assistance (eg., amanuensis, nursing mothers, senior citizen)
- Award List preparation status for validation procedures to ensure reflection in the grade card.

7.2.4. Point of access for Regional Centre

- Marking the presence or absence for a counselling session scheduled and informing the LSC for a pooled counselling if the probability of thin attendance is known
- Improved individualised advisory services through consolidation of real-time student data LSC wise programme wise.
- Enhanced personalisation of service to students via RC portal access – tracking student movement and reminders for continuing the programme of study enrolled so that access could lead to success.
- Validation procedures for Award List prepared to ensure reflection in the grade card.

- Visit of official to LSC

7.3. Financial Activity in Student life cycle management

7.3.1. Point of access for student

- Receipt for the financial transaction with the cause mentioned

7.3.2. Point of access for LSC

- Automated bill claim calculations for a programme in an academic session on the basis of attendance.

7.3.3. Point of access for Regional Centre

- Automated fee calculations indicating the revenue generated for a programme in an academic session
- Status of bills received for settlement
- Tracking bills submission in correlation with Student attendance and counselling sessions scheduled.
- Assessment of expenditure for Billing processes and improved cash flow against the grant received.
- Improved modalities for tracking financial expenditure.
- Earmarking accountability through integration with RC/LSC accounting and reporting features by competent authority and presenting to the authorised signatory.
- Improved financial control and efficiency of budgeting
- Visibility of expenditure to optimise interaction and consensus between the field level functionaries (LSC/RC) and stake holders/sanctioning authority for grant.
- Centralised financial management reporting with facility for immediate deposit in the bank.

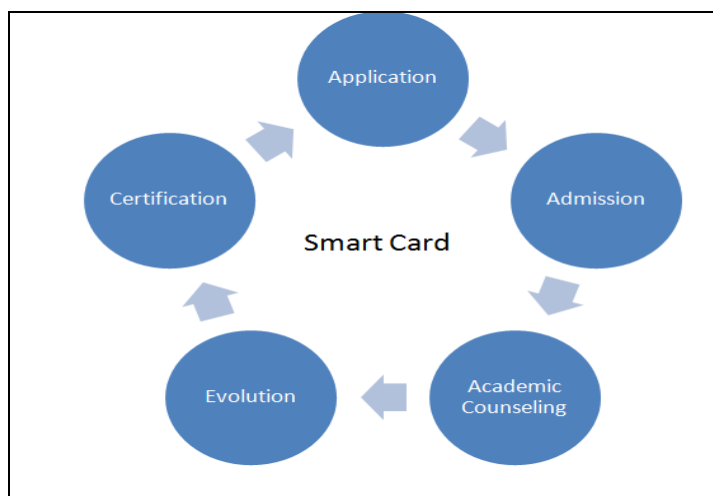
8. WHY SMART CARD IS NECESSARY FOR DTI

Usage of smart card technology is one of the best solutions to look into and revamp the process of Learning Management system. These revamps and overhaul the entire learning management process in terms of learning system from the administrative perspective and also from Learner Perspective. At many times, under usage of process in the existing system would be wiped out. This gives a clear picture and overall usage experiences for learners and Administrative offices. The use of State of Art technology with the set in standards of Smart Card system will bring motivation and also helps to innovate and explore new avenues of learning systems. Perhaps if we look into deeper we can bring the revenues through the smart card system.

8.1 How Smart Card Fits in DTI

8.1.1: Process flow and Smart Card usage

All stuffs relation to learner's perspective on Smart Card and it usage were discussed in the present paper. Fitting in DTI Process, with this model we can manage the Entire learner's activity. Below is the High Level process fitment for Smart card and related process.

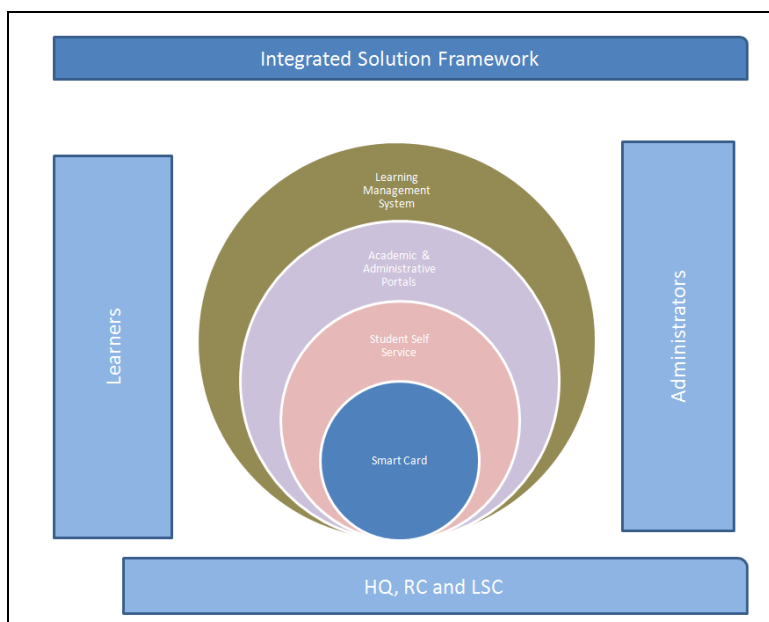


8.1.2: Holistic approach for Digitalisation of Learning Management system

Learning Management Systems (LMSs) have been widely used in higher education due to their many advantages including flexible learning times and unlimited distance education (Hamuy & Galaz, 2009).

With effective utilization of Smart Card, visualize the effective integrated framework of Application, Solution, Process and Stake holders is shown in High Level below

A learning management system (LMS) is a software application for the administration, documentation, tracking, reporting and delivery of educational courses or training programs. LMSs support a range of uses, from supporting classes that meet in physical classrooms to acting as a platform for fully online courses, as well as several hybrid forms, such as blended learning and flipped classrooms (Wikipedia 2017).



Since the increased development of the Internet, the LMS concept has been broadly applied at various higher education institutions around the world. LMSs helps instructors and learners discuss the course content by posting and responding to each other, maintaining student learning tracks, and managing learning activities in an online environment (Falvo & Johnson, 2007).

The Learner Management System will help the DTI to track the Learners, the Personal Details, Financial Details, Program Schedule, Assessment details, Feedback details, Lecture material used by the faculty

(PPTs), Assignments, all communications related to class schedule, examinations, rules, policies etc., It is also helps to Student self services to update the personal information on their own. Further it also helps to send their queries (administrative or academic) through the Contact us & ask faculty options.

8.2 Process and Applications of the proposed Smart Card in DTI

The Functions and Applications of the proposed Smart Card in DTI are on the basis that the information irrespective of being fed either by student or LSC or RC can be accessible by RC. However, the RC can give viewing rights to LSC if demand arises. Since, it is assumed that the Head quarters will be responsible for certification, the Regional Centre will not have correction rights related to confidential matters but will have viewing rights. But, confidentiality activities are totally restricted for viewing by the student. Every function demanded to be served by the smart card is on the principle of storage of data, processing of data and retrieval of data on the basis of push buttons or menu options. Limitations exist for freelanced dialogue and self expressive discussions.

The Process and Applications of the proposed Smart Card in DTI are given below:

Process	Application
Identification ➤ Verifies identity by displaying stored demographic data, photograph, or biometric; ➤ Allows implementation of automated identity verification processes through machine-readable cardholder data; ➤ Provides for multi-factor authentication of identity.	Basic identification Extended identification Licenses Permits
Physical Access Control ➤ Authenticates individuals and permits access to physically secure areas.	➤ Learner Support Centre ➤ Regional Centre ➤ Head Quarters (Web based application for each entity based on the role and functions)
Logical Access Control ➤ Authenticates individuals and permits access to accounts and networks.	➤ Internet ➤ PC personalization ➤ Smart phone ➤ Authentication - Digital signature - Biometrics - Passwords/single sign on
Portability	➤ One of the most fundamental smart card characteristics is its data portability. ➤ By adopting smart cards, an Institution is able to maintain data on a form factor (i.e., the smart card) that can be transported to any physical location. ➤ Data on the card can be accessed wherever and whenever it is needed.
Information Sharing	➤ Smart cards enable the sharing of data across disparate systems. ➤ The smart card can move information between applications.
Multi-Application Enabler	➤ By leveraging the robust technology associated with smart cards, more than one application can reside on

	the card platform. ➤ Some examples of applications are time and attendance, physical and logical access, and e-purse.
upgradable Applications	➤ Smart cards built on an open platform are dynamic and can accept new applications and data structures even after the card has been issued.
Support for Multiple Technologies	➤ Smart cards support different technologies and interfaces including contact and contactless RF. ➤ Further, chips can be embedded in proximity cards and can also be combined with magnetic stripe or bar code technologies.
Record storage and retrieval	➤ Stores data files and records, which can be displayed on a terminal or used to populate standard forms. Eg., Demographic data, Programme wise enrolment, No of time Learner visiting LSC/RC for Academic transaction, Attendance tracking etc.,
Financial services	➤ E-Wallet (Online transaction and add on money) ➤ Cash Book
Add on functions	➤ Send an auto generated e-mail to a student ➤ Display counselling schedule for online register ➤ Display Academic Calender ➤ Go to payment at cash desk and fee calculation ➤ Display the student's program/course content ➤ Display an overview of the student's academic work

8.3 Tools necessary for the proposed Smart Card in DTI

The proposed Smart Card for use in public DTI need the software and hardware to access the portal; interact in the portal; to do the financial transaction for specific activity; to get linked with peers, academic counsellors, LSC, Regional Centre; and for storage purposes for future retrieval and use. The software and hardware are discussed under the following head

Access Control Tools: This involves both the card reader and the biometric authentication. In built Security features that allow the card to operate as an authentication token for secure logical access to terminals and networks (such as local area networks (LANs) and the Internet) are programmed for individual client and individual academic activity. A special provision for physical access to Regional Centre/Learner Support Centre and other facilities of the DTI is also programmed to response to interaction.

Payment Tools: Linkages with payment gateways for specific usage linked with academic activity can be inbuilt in Smart card which can serve as credit, debit, or stored-value payment and/or payment token instruments. Linkages with payment gateways provide the capability to access financial accounts and transfer funds between accounts so that the necessary fee is credited into the account of the DTI and a receipt is made available to the person to remit the fund.

Information Storage and Management Tools: On-card information availability can reduce the amount of time spent locating hard-copy paperwork. Linkages between the access tools and payment tools with the LMS need to be stored for future retrieval and to personalise the solution for individual student query. The longer the stay of the student in a DTI, the more information needs to be stored. Hence, minimum capacity of storage in line with gifted learners and facility for add on storage who struggle to complete even beyond the maximum prescribed period will be made.

9. FUTURE RESEARCH DIRECTIONS

The following recommendation is being proposed for further studies

- Cost benefit analysis: Against the usage for consolidating the activity of Learner may be documented
- Smart Card and Interactive SMS: This is one of the useful things can be done in future where the learners can be virtually linked with Interactive SMS. Say for Eg. If a learner enters in campus for Some reason, on physical contact of the card, the need of the learner can be interpreted through interactive SMS with some CRM technology and this leads to effective servicing and monitoring of movements of the learners
- Smart Card and Student Self Services: Again as the common contact of smart card, the student self services can be accessed through some portal based services. Also it can be effective catalyst for Learning Management Systems.

10. CONCLUSION

With the increased flexibility of distance learning tracking the Learner for fulfilment of mandatory requirements become herculean task. Manual records are difficult to consolidate and also it is time consumed. With the suggested Smart Card concept and it's usage for the various activities linked for the Learner support with the embedded chip and it may pave way for consolidation of records related to the Learners. So that such pre-requisite can be easily coordinated for the certification of the learners. The Learner Management System provides a simple interface for the maintenance of student information and to better support services to the learner. It can be used by educational institutes to maintain the records of students easily. Smart card will achieve this objective easily through the LMS which manages all students' related information includes the admission of students, monitoring of students attendance and students progress in their studies, students fees payment and report generation fee reconciliation.

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