



Robotic Process Automation to Smart Education

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Abstract: Today, the rise of Artificial Intelligence (AI), robotics, and other digital technologies are profoundly creating a demand for new professions with evolved digital skills. Educational institutions must adopt these technologies in order to promote digital skills development and empower students to lead active and creative digital lives. Recently, the education sector is ready to witness a revolution with robotics process automation (RPA) technology. RPA offers traditional companies a pathway to digital transformation. It focuses on the elimination of inefficiencies and the effort of human resources that is wasted while executing mundane tasks. RPA helps teachers, educators, students as well as parents directly or indirectly. This solution revolutionizes the education sector as sorting out the registration, reduction in processing time, automating attendance and making sense of it all and improved administration. The objective of this research article is to introduce RPA in education and propose an RPA model to the smart education system. RPA can help out here by saving time and under a budget which is a limited & crucial resource for educational institutes.

Index Terms - Smart Education, e-learning, Robotic Process Automation, Software Robots, Virtual Business Assistant.

I. INTRODUCTION

Education is definitely one of the most difficult sectors to automate. Effective education has to do with more than just transferring information from teachers to students. Modern education requires social interaction and an adaptation to the individual student's learning needs and capabilities. Meaningful human interactions are essential in education and are almost impossible to automate. The rapid adoption of smartphones/ smart gadgets for educational purposes and the availability of high-speed Internet are the prime factors boosting the smart education. Besides this, the adoption of e-Learning (nowadays smart education) would help in increasing the overall smart education. Smart education is a cost-efficient and more convenient way of learning as it provides training and tutorials from experts, improved courses, certification programs, and others. Despite the great leaps such systems have taken, automation alone cannot solve every issue in the global education system. Using the incredible potential of automation improves educational content, strategy, and policies [14]. Focusing on automating the teaching process may result in an entirely digital learning experience that promotes outdated skills and fails to prepare students for the future.

The education sector is ready to witness a revolution with this new-age technology [21]. Current technologies are automatically able to grade and provide students with feedback. Automating tasks in education may require artificial intelligence (AI) and Machine Learning (ML) technology. AI can able to plan, strategize and make impactful decisions under unpredictable circumstances. AI technology is even being trained and refined to perform automatic essay scoring. Chatbots (like Jill Watson) can allow millions of students to have their work reviewed and all their questions answered at a minimal cost. ML has the potential to improve student engagement, create clearer communication channels between teachers and students, and to develop less biased grading systems. Smart education seamlessly manage student data from admission up until graduation. It enable easy access to attendance, schedules, grades, library catalogs, events and more. It improves documents processing and security. It also enable teachers to better advice and support students success. These factors motivated to apply RPA technology to smart education.

The RPA technology eliminates inefficiencies and the effort of human resources that is wasted while executing mundane tasks [9]. It leads the creation of a virtual workforce and creates multiple possibilities for educational organizations. RPA helps teachers, administrative staff, students as well as parents directly or indirectly. Automation encompasses a diverse set of technologies ranging from continuous delivery and continuous integration tools to hybrid cloud management to the machine vision tools deployed in autonomous vehicles. RPA is a subset of business process automation (BPA), for the use of technology to execute the activities and workflows that make up a business task with minimal human intervention.

According to Karl Utermohlen [13], RPA is an essential part of where ML is headed in the education industry. RPA allows teachers to aid students who may have a disability or a different learning background to grasp the concepts of their classes with higher accuracy. This ultimately leads to better grades, the development of more applicable skills in the real world, and a higher chance of finding career paths that suit each student.

1.1 Traditional Education System

In the traditional teaching system, there is still a lack of communication between education and technology. In many educational institutions, a lot of time is spent on educational activities that do not add any value to the core aim of their very existence. According to Michael Davison [17], the teachers prepare learning materials, manually grade students' homework & class tests, provide feedback to the students and their parents during the learning progress. Hence, the teachers may be burdened with an unmanageable number of students, or varying student learning levels and capabilities in one classroom.

- i. For instance, attendance of the students' needs to be taken several times a day. This data has to be sent to the central office for different purposes. This is one of the inefficient system.
- ii. Students have generally been pushed through a "one-size-fits-all" gauntlet of learning, not personalized to their abilities, needs, or learning context.
- iii. The administrative department is usually the one charged with most tasks, and is the one that takes most time for paperwork. Maintenance of records, compilation of attendance reports, communicating with students' parents, issuing memos and circulars, scheduling meetings, reservation, facilitating result and fees & fines related documents to students, managing employees, collaboration, vendors records are only a few of the tasks, the onus of which lies on the administrative staff's shoulders.
- iv. Massive number of applications to be filtered and assessed on standards is the primary task in terms of time taken.
- v. Seasonal peaks have staff overburdened with responsibilities, and most being repetitive, it results in numerous errors.
- vi. Time & money are crucial and competition is intense, saving time on monotonous tasks is the need of the hour.
- vii. Automated communications and information exchange is a thing of the present and relying on human capabilities alone does not meet the standard requirements.
- viii. With the changing landscape of payment modes and means, automated ways of tracking can benefit large-scale operations.
- ix. The traditional way of interacting with a Web or Mobile application is to first fully understand its sitemap to locate relevant Web forms, fill all search fields on the form and then submit button to get the desired result. This is really time-consuming from the development perspective as well as it is a less intuitive solution for users with no smartness embedded in it.

In contrast to this, the Automation or Chatbot has a simple one conversational screen that caters everything for everyone. Adding cognitive services to the Chatbot will make it smart, able to self learn and improve with experiences.

1.2 Solution to the problem

The recent advances in AI ML and IoT technologies overcome the above challenges. They can put an end to this inefficient system. These technologies collect and analyze data that students generate (such as e-Learning log files) when they interact with digital learning systems. However, RPA is a boon for the educators, administrative staff and parents. In education, the learning needs to continue to evolve and that technology and tools can help to enable that. The education sector must evolve to embrace new learning styles and technologies that can captivate students, while concurrently maintaining integrity of the knowledge in areas like literature and history that help create well-rounded people. This should really be the core of change and digital transformation efforts in education.

The objective of this paper is to introduce RPA technology into educational sector and to propose a RPA process model to smart education. The proposed RPA model is a reliable to smart education that helps teachers and students to do their tasks in a shorter time but also allows them to coordinate their work.

II. LITERATURE REVIEW AND RELATED WORKS

This section discusses the background details required to write this research paper. This includes the necessity of automation in education, digital transformation, emerging technologies available to automate the educational processes.

2.1 Automation in Education

Educational institutions have the outsized responsibility of educating the next generation. They are very similar to other businesses organizations, and face many of the same challenges. The educators of educational organizations should be left unscathed, and with more time to perform their very human tasks after this technology is fully realized. Rather, automation will have the most benefit behind the scenes. According to Neil Kinson [19], education in particular is ripe for automation. Automation's impact in education will continue to augment the way staff and faculty work and improve how students engage and learn. For example, technology to automate grading of multiple-choice assignments has saved teachers hours upon hours, liberating them from such slow and repetitive activities to make room for more meaningful, personalized interactions with students. This is a key example of how automation and robotics will enable educational organizations to do more with limited resources and budget constraints. Once fully operational, faculty will be able use automation to take the busy work out of their jobs, freeing up time for meaningful student interactions in the classroom.

2.2 Digital Transformation

Today, education must be collaborative and interactive. Teachers are making drastic changes to the way they approach instruction with technology in the classroom. As the educational sector becomes more competitive, digital transformation is now becoming a necessary means of survival, as this new digital world requires educators to adapt and adopt digital technologies, methodologies and mindsets. Digital transformation positively influences student learning by opening a world of endless possibilities and collaboration. According to Alcatel-Lucent [2], "digital transformation is a physical and philosophical change designed to meet the ever growing demands of the students, faculty and campus to create a learning environment where everything connects. This is an ecosystem that combines technology, services and security to bridge the digital gap to create collaborative, interactive and personalized learning experiences".

Campus security, information security, student success, IT strategy, data enablement, student centric services, affordability, digital integration and AI technology are some of the issues that drives digital transformation in education sector. Creation of a digitally transformed campus involves build a strong IT foundation, foster successful students, create a safe campus, deliver state-of-the-art cyber security and deploy operational efficiencies. To understand a full and sustainable digital transformation, it is important to examine the potential challenges or roadblocks an institution might face. Some of the digital transformation trends in education are customized learning experiences, improving accessibility in the geographic sense, Internet of Things (IoT), secure campus, etc.

2.3 Modern Technologies in Education

The recent advances in technologies are AI, ML, IoT, Big data and ERP can put an end to the above inefficient education system. Artificial Intelligence. Over the past few years, the success of data-fed virtual teaching assistants and smart enrollment counselor chatbots has had the Higher Education world abuzz using AI on campus [25]. HEIs hope AI will help them offload time-intensive administrative and academic tasks, make IT processes more efficient, boost enrollment in a climate of decline and deliver a better learning

experience for students [16]. HEIs are dealing with high dropout rates. Today's college students need learning to be more engaging and personalized. Technology, especially AI, can help with both those issues. AI, fed with and trained by Big Data, can deliver a personalized learning experience. Teachers can gain unique insights into the ways different students learn and provide suggestions on how to customize their teaching methods to their individual needs.

Today, students and teachers are adopting different ways of learning and absorbing information to improve their learning experiences in the cocooned world of education are increasingly using AI. AI tools and chatbots have become a game changer in the rapidly evolving EdTech world [15]. AI has the capacity to accelerate and scale personalized learning. The personalized learning environment allows educators to zero in on individual skills and weaknesses and solve their problems. AI helps in strengthening teaching practices. Advances in AI are enabling teachers to gain a better understanding of how their students are progressing with learning. This enables teachers to create customized curriculum that suits the specific needs of the learners. Most of the social networking sites that are education-oriented tend to employ AI algorithms. These algorithms bring a personal touch to the learning process, making it more appealing to the learner. AI provides tools develop more accurate and detailed picture of how the human mind works. AI's digital, dynamic nature also offers opportunities for student engagement that cannot be found in often-outdated textbooks or in the fixed environment of the typical four-walled classroom.

According to Shailaja Neelakantan [25], data-powered AI tools help higher education drive enrollment and streamline operations but scaling up their use and training is a challenge. Ma Yizhi and Siau Keng L [16] studied analyzes the impact of AI on higher education. This study would also be looked at how higher education can contribute to AI development.

Machine Learning (ML). ML technology is a subset of AI that helps smart devices learn from all previous data and make intelligent decisions. ML has become a new frontier for higher education. ML fosters personalized learning in the context of disseminating education. ML gives more personalized learning experiences [11] that have the potential to improve student engagement, create clearer communication channels between lecturers and students, and to develop less biased grading systems. ML is a method of data analysis that automates analytical model building. Some of the application of ML in Education are to predict a student's future performance (prediction), process efficiency (includes scheduling, grading and organization), and working with existing platforms.

The platforms that are leveraging ML in education [23] are content analytics, learning analytics, dynamic scheduling, grading systems, process intelligence tools, predictive analytics and data mining, and lots of back office stuff. The adoption of ML technology has enhanced the concept of crowd-sourced tutoring. The crowd-sourced tutoring is to assist from tutors, classmates who fill gaps in understanding by supplementing the content learned in class. Students are using social networking sites for learning purposes (like Brainy). In addition, Recommender systems [4] are the more obvious target of ML usage. Recommender systems are illustrated on some of the more prominent software platforms like Amazon, LinkedIn and Twitter. Researchers in the education sector consider recommender systems as the most utilized systems in modern times.

According to Karl Utermohlen [13], some of the ways ML is transforming education are more customized learning experience, predicting career paths, less bias in grading and setting up appointments. According to Ibtehal Talal Nafea [11], ML can be used in review a lesson that was hard to understand. ML in education works in harmony with students' needs, and at a time and place, which suits them best. In addition, Virtual assistance plays a crucial role in education and is a good forum for ML use. Both ML and virtual assistants are used to interpret patterns and human interaction, which supports deeper learning and provides users with fast and accurate data. According to Philip Piletic (2018), AI and ML are shaping the future of e-Learning. In addition, Deep learning (DL) approach is being applied in the education sector for developing course material that can be incorporated into a comprehensive learning curriculum. For example, the advanced grading tools can also serve as a guide in comprehensive curriculum design. The AI technology into e-Learning help all stakeholders to benefit from a more effective educational infrastructure. The use of ML in education technology has been more significant in its overall educational applications.

Internet of Things (IoT). The IoT enhances the education itself and provides advanced value to the structures and environment. According to Savaram Ravindra [24], a smart education institution (which uses IoT technology) with the facilities operating smoothly promotes a higher level of personalized learning. The smart devices used in a campus utilize mobile networks / Wi-Fi network for receiving instructions and sending data. An IoT system for education institution helps to keep track of major resources, create smarter lesson plans, design secure campuses, enhance information access, and much more. With its set of advanced tools, IoT can be regarded as a new method of classroom management. The IoT in the education sector includes interactive learning, security and educational apps.

Palanivel Kuppusamy [22] looked the requirements and architectures required for smart education. It is proposed to design a scalable and flexible IoT architecture for smart education. IoT increase in student engagement has been mammoth. Interactive learning was devised with the ulterior motive of putting student's needs ahead and presenting educational content in a manner that will prove to be engaging and interesting. The curiosity levels of students increases and learning becomes a fun exercise.

Big Data Technology. Big Data provides a basis for precise positioning services and enables a new era of customized education [18]. By analyzing students' Big Data, educators can match students' personalities and learning preferences with teachers' personalities and teaching preferences to find the most appropriate teachers for students. By using intelligent algorithms to parse data into standard, modular, or even structured data, teachers can analyze students more accurately and provide services that are more effective. Hu, Zhifeng [10] carried out research on the application of big data in smart education system, promoting the transformation of information portals of universities into service portals.

Big data & analysis technology can provide strong data analysis for student affairs management. The objective in the application of Big Data in smart education system is to visualize data and to provide predictive analysis according to visualized data. Big data technology can mine the information and knowledge hidden in a vast amount of data and provide the basis for social and economic activities of human beings, improve operational efficiency. Big data analysis and mining technologies can be applied to improve teaching quality in universities, analyze behaviors of users in campus network and public opinions, which will effectively promote the in-depth integration of information technology and teaching.

2.4 Enterprise Resource System (ERP)

Technology has positively influenced the education sector with groundbreaking breakthroughs. Today the classes are run by smart-education software and thanks to ERP solution for the education industry, the operational aptitude of the sector has soared to greater heights. The list of benefits of ERP solutions include points for every department of the educational sector. Right from admission to felicitating the convocation degrees, ERP plays a vital role in simplifying the complex processes of an educational institution. The

education industry enjoy a plethora of benefits through ERP implementation like admission, time management, institutional calendar, assignments, examination, financial management, hostel management and miscellaneous activities.

According to Nidhi Chamria [20], Enterprise Resource System (ERP) has long been a primary factor for easy and organized management of various industries. It offers a complete range of solutions to ensure smooth functioning of all branches of the sector. ERP influenced the educational realm with innovation and simplicity. The aim of implementing ERP solution for education industry is to streamline the process of various functions from scratch to the top. With ERP, an educational institute can seek out a variety of benefits. ERP has made the learning process more comprehensive and simplified for students; there is still a lot of untapped potential in the industry.

2.5 Smart Education

The world is moving ahead, with noticeable growth in technology and the advancement in the learning system. The introduction of smart devices/ gadgets such as computers, smartphones, laptops, and other electronic devices, etc. are playing a vital role in the classroom for smart education [3]. These smart devices are gradually replacing the textbooks. With these smart devices, the students can access knowledge anytime, anywhere and with anyone. Some of the smart education features are smart classroom, AR/VR, gamification, learning App, biometric attendance and facial recognition, digital transformation, application maintenance and custom development. According to Janelle Cox [12], smart classroom solution overcomes the above issue in the traditional teaching system. A smart classroom is highly emphasizes online studies for those who are unable to conceive study materials and other stuff. A smart classroom has an Interactive whiteboard, which allows the students and learning material with editing access. It connects with smart devices, which has access to display. Smart classes can achieve distance learning and provides an interface between teachers and students where they can interact, communicate, collaborate, and share their ideas on different topics. It can be used in seminars for presentations on rural development ideas.

- *AR and VR.* Augmented reality (AR) and Virtual reality (VR) has revolutionized the education sector through smart learning. AR superimposes information in the form of sound, images, and texts, which is more interesting and provokes you to learn and utilize your time more on learning. On the other hand, VR is an artificial digital ambiance that has completely changed the real world. VR facilitates with amazing real-time experience and provides a completely computer-generated world around, where students can explore the environment and students can even interact with it.
- *Gamification* can be used at any place to change the mechanism and make its system more interactive and engaging. This process itself motivates users to emphasize productivity in a way to win the race. For instance, gamification has introduced to the education system, where it allows students and teachers to both pursue study in an interactive way, and reduce unnecessary pressure of learning.
- *Learning App.* The e-Learning App helps educational institutions to provide training support and smart solution for complex challenges. It provides a better user-friendly experience. Students are more indulging in e-Learning apps for educational purposes, taking online learning classes, group discussions, etc.
- *Biometric Attendance and Facial Recognition.* There is a growing need to use Biometric Attendance and Facial Recognition technologies to record automatically the attendance of students in the smart classroom. They play a vital role to track students' records and maintain them to the cloud-based system. As a result, it helps to decrease keeping manual records and chances of proxy. With smart classes, biometric and facial recognition stuff will surely make them feel more enthusiastic about education and push them to learn more for a brighter future.
- *Digital Transformation, Application Maintenance & Custom Development.* Digital transformation with up to date cutting-edge technology applications, which makes every task easy to handle. These application customization, integration and implementation call away Human Resource Management System (HRMS), ERP, learning portal, e-Learning core, document management system, e-Signature, survey platforms, digitization of paper processes, etc.

Adrián Carruana Martín et al, [1] did a systematic literature review to understand how this term was used, what the technologies behind it, and what promises were made. They concluded that the term was fuzzy. Indeed several developments available today could make educational technologies much more adapted to the learner and therefore underpin the learning in a smarter way. According to Daniel Faggella [5], the components of smart education are smart contents, intelligent tutoring systems (ITS) and virtual facilitators & learning environments (VLE). Emerging technologies such as VR/AR help further optimize teaching scenarios. They have potential to become a standard tool in the education market.

2.6 RPA in Education System

There are many areas in the education system that are plagued with manual tasks that are better suited for robots. As the next generation of learners are more tech practical understanding, they can access what they are familiar with in the consumer technology they already use [8]. Some of the areas in the education system suited for robots are presented below:

- i. Search portals and self-checkout at Libraries are becoming more and more commonplace. This frees Librarians from such repetitive and low-value tasks so they can help students with more educational inquiries, while giving students more autonomy through technology.
- ii. The classroom has plenty of areas where automation can improve the student and teacher experience. From onboarding a new student in a class, to helping people understand how and where to access school resources, these processes can easily be simplified and streamlined by way of automation to further free up faculty's time for more impactful work.
- iii. Spending such resources on operational management does make sense where the goals are to attract and educate more students more effectively by way of automation. This would release resources for activities that directly affect core constituencies for students and educators.

Today's, RPA can transform education as a more customized learning experience, predicting career paths, less bias in grading, and setting up appointments. RPA technology will ultimately reduce the pressure on students and creating a more comfortable learning experience for all parties. For example, RPA uses smart algorithms to determine which teaching methods are likely to work on each student. Technological advances such as this one are allowing lecturers to aid students who may have a disability or a different learning background to grasp the concepts of their classes with higher accuracy. This ultimately leads to better grades, the development of more applicable skills in the real world, and a higher chance of finding career paths that suit each student.

2.7 Robotic Process Automation (RPA)

RPA is a versatile, scalable technology that can apply to many relevant industry processes. RPA technology is particularly applicable to processes that typically are consistent and routine, high volume, prone to human error, limited in requiring a person to make a decision

and manual data entry or “swivel chair” work. RPA can simplify the way users automate tasks by interacting with multiple applications at once. The dynamic nature of RPA sets it apart from previously developed automation solutions, making it an important automation tool that drives digital transformation and the future of work. It is defined [6] as: “RPA is the application of technology that allows employees in a company to configure computer software or a “robot” to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems”.

RPA is the use of specialized computer programs, known as software robots, to automate and standardize repeatable business processes. Software robots mimic human activities by interacting with applications in the same way that a person does. Software robots work directly across application user interfaces, mimicking the actions a person would perform, including logging in and out of applications, copying and pasting data, opening emails and attachments, and filling out forms. Software robots have the flexibility to intuitively respond to stimuli and changes in business processes - increasing their intelligence over time. All bots can be monitored and audited over a centralized Server, IT would still be able to maintain central control over bots in use, while promoting flexibility in the organization for employees to deploy their own custom solutions. According to Karl Utermohlen (2019), RPA is an essential part of where ML is headed in the educational industry. RPA technology can amass large chunks of data pertaining to students and offer them an experience that fits their needs. For example, RPA uses smart algorithms to determine which teaching methods are likely to work on each student.

Classification. The three types of RPA are unattended automation, attended automation and hybrid automation [20]. *Unattended Automation* execute processes on applications even if the application is not running, and they respond to changes in processes immediately. The robots are triggered automatically, work 24/7 basis without interruption and do not require human intervention. Typically, the processes executed are repetitive, high-volume, logic-based tasks involving the entry or transfer of data across systems. *Attended Automation* are installed on employee desktops assisting users to complete businesses processes more efficiently and accurately. Attended Automation is often deployed in a front office environment where robots complete portions of a process or guide users through a complex process. When robots automate steps of a process, employees enjoy increased productivity and process accuracy while focusing on human interaction and other business critical tasks. *Hybrid Automation* combines both unattended and attended automation into a single solution enabling interaction between your human and virtual workforces. Humans can initiate processes then pass certain tasks to robots with full visibility into the status of the task, while robots can pass tasks back to humans when certain input is needed. The result is an end-to-end solution that maximizes process efficiency.

How RPA Works. RPA products broadly comprise three fundamental elements: a set of developer tools, a robot controller, and the software robots. The *developer tools* are used to define jobs. The jobs are sequences of step-by-step instructions a robot follows to perform a particular business process. The instructions, which need to be very detailed, may include business rules or conditional logic, such as if/then decisions. Developer tools are used only in modeling the processes and making changes to them; they are not required to actually run the processes. The *robot controller* plays three essential roles. It serves as a master repository for defined jobs, the robot controller facilitates version control. The robot controller assigns appropriate roles and permissions to users, and provides controls and workflows to govern the processes of creating, updating, testing, reviewing, approving, and deploying jobs to the robot workforce. Finally, it assigns jobs to single or grouped robots, and monitors and reports on their activities. *Software robots* carry out instructions and interact directly with business applications to process transactions. Some robots keep detailed logs of their actions and decisions for compliance and audit purposes, as well as to help companies identify additional process improvement opportunities.

Benefits. RPA is a user-friendly and cost-effective tool. The benefits of RPA [27] include low technical barriers, increased accuracy, meet regulatory compliance standards, existing systems remain in place, no interruption of work, improved employee morale and employee experience, reliability, consistency and increased productivity. Advanced cognitive capabilities such as ML and AI are allowing bots to more intelligently interpret the interfaces they work across, better handle errors, and manipulate unstructured data. ML allows bots to recognize patterns over time. In many cases, RPA can bring immediate value to core business processes including payroll, employee status changes, new hire recruitment and onboarding, accounts receivable and accounts payable, invoice processing, inventory management, report creation, updating CRM data, software installations, data migration, vendor onboarding, etc. For example, RPA can record the actions that need to be replicated, map fields between the two interfaces and automate this repeatable task i.e., saving hours of valuable staff time. With RPA, employees have access to a self-serve automation tool that will empower them to reduce their own tedious work.

2.8 RPA Solution Architecture

RPA architecture is the most critical factor that needs to be analyzed. The essential element that needs to be understood is the architecture of the particular product. This helps in understanding the implications of where it should not be used. The factors to be considered RPA solution architecture are configuration, exception handling, integration, security and usability.

- **Configuration.** Every RPA application holds a feature designed in specific to accelerate and also to simplify the editing of the configuration all the time. This ensures that the effective deployment of automation and also adds a lot of support towards building the required internal capabilities..
- **Exception Handling.** With stable exception handling, the orchestration of automation in the workplace can operate smoothly and reliably.
- **Integration.** RPA tool should be able to integrate with various other systems and technologies that might be deployed in an organization’s business processing. This achieves stronger integration capabilities, the better and robust automation.
- **Security.** The security features and measures are quintessential of an automation toolkit.
- **Usability.** Usability is the most important factor that plays a significant role in the decision making. It makes the overall configuration process and the administration process more efficient. The more accessible software can ensure quicker scalability, ease of deployment, and higher levels of adoption by the customers.

The factors discussed above make sure that RPA tool and its architecture better. Fig.1 gives a brief depiction of a typical RPA solution and its architecture. It is not a single tool, but is a combination of various tools, platforms and also various infrastructure elements to form a complete RPA tool or a solution. It has many blocks with high-level details in the solution architecture.

RPA Applications. RPA is well suited for enterprises and enterprise applications like ERP solutions (example, SAP, Siebel, or massive data processing or records processing applications). Most of these applications are data-centric and data-intensive with loads and loads of set up and repetitive process activities. These applications can either physical or virtual.

RPA Platform. RPA in the cloud always acts as a shared repository to ensure the storage of all the software robots and the RPA based resources using the tool. These RPA assets can further be divided across software robots (as repeatable sub-processes) library. Scheduling,

distributing and monitoring the execution of software robots are the features and capabilities provided by an RPA platform. Given all the information available about RPA assets and executions, the RPA platform further provides the ability to develop meaningful analytics about your software robots and their execution statistics. Most of the critical capabilities that are expected to be available in the RPA tools. These RPA tools can able to automate a variety of application environments such as Web, Desktop, and Citrix environments.

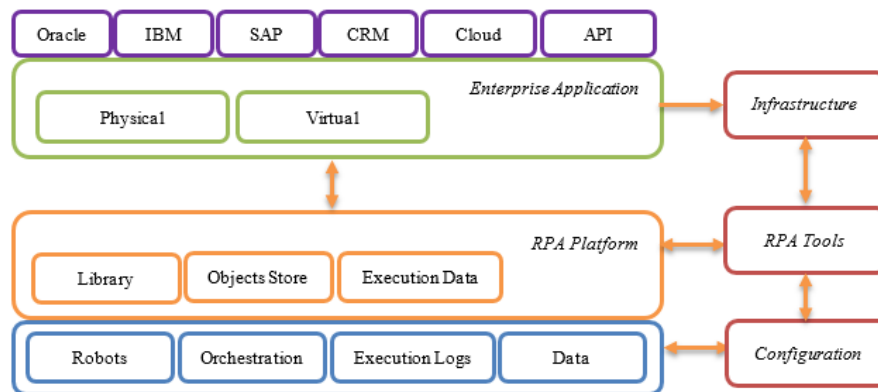


Fig. 1. RPA solution and its architecture

RPA Execution Infrastructure. RPA execution infrastructure can be a bank of parallel physical or virtual lab machines, which can be controlled based on the usage patterns. Scaling up or down the number of machines in parallel to achieve the task of automation can also be done, and this can be left unattended to for as long as it requires no further human interaction or intervention. The configuration management is needed for versioning of RPA assets as the underlying application on which software robots are developed may continuously be updated to introduce newer versions.

The RPA solution can always be fed on the feedback, to make the automation model more efficient. The users can execute the automation model to ensure the automation is always running and in turn, the tasks that are configured via this automation are performed. On a successful execution of these software robots, it performs a retrospection to understand and identify critical areas where there can be better suggestions implemented to perform these tasks in an even more efficient and effective way. The goal of this RPA model is to achieve the best-suited business automation model that suits the business requirements and needs. Fig. 1 provides a better depiction of the RPA tool as a layered design and explains every layer in the RPA tool's architecture. It also accentuates the already existing understanding of the software architecture. This is a combination of various layers of applications and tools that come together to make this whole system and the architecture.

2.9 Related Technologies to RPA

The technologies that are related to RPA are workflow management and Business Process Management (BPM). According to Elena Haidukova [7] workflow management means overseeing a process from the beginning to the end. This involves individual tasks, which move from one-step to the other until a process is completed. The concept of workflow management optimizes the organization's business processes through automation. Workflow management may use software tools to automate parts of the work and keep track of it. The workflow management software can enable them to automate their workflows and increase productivity in the process. BPM is a technology that has made a major contribution to the digital transformation strategies of many organizations. BPM involves designing processes, executing them across systems and people, managing tasks, and optimizing it all continually. BPM concentrates on reshaping the existing business processes of an organization to achieve optimal productivity and efficiency. BPM software helps to streamline and improve the way business processes are carried out. BPM process improvement initiatives are usually large-scale projects and they can affect the technology, customers, and employees of your organization and bring about major transformation returns.

Deploying BPM and RPA together, they will provide us a powerful platform to enable digital transformation throughout your organization. BPM and RPA have similar goals of increasing efficiency and productivity.

2.10 Methodology

The research methodology used for this research objective are stated below:

1. Literature was collected with the intention of verifying if a similar hypothesis had been raised previously, or if RPA applied to education.
2. Finding no evidence to prove that no business model is available. The absence of an RPA business model provided the opportunity to present the idea.
3. Identify the desired situation to apply RPA in smart education. Call for the development of the functions of RPA in smart education.
4. Once the concept and the required functionalities have been established, the business model of the RPA is presented.
5. Finally it is finished with use cases.

III. RPA MODEL TO SMART EDUCATION

Technology such as Wi-Fi, Mobile and SMART interactive displays is bridging the gap between students and teachers. The successful adoption of these technologies builds a high-performance educational data center (EDC). EDC helps education informatization move towards the educational cloud. Educational cloud leverages cloud computing in collaboration with Big Data technologies to provide data pooling services, as well as full-stack cloud service capabilities. Education institutes are provided will complete, end-to-end (E2E) services that facilitate learning, and encourage collaboration. This ensure students and teachers are provided with best-in-class technologies to facilitate successful learning and teaching experiences.

3.1 Smart Education Solution

Smart Education Solution (SES) transforms paper-based processes into a fully integrated and automated digital environment and assisting in analyzing performance based on any measurable key performance indicators (KPI). Education management solution allow educators to consolidate all their documents, benefit from improved collaboration and communication through Web or smart devices. This maximize the use of educational resources in ways that directly benefit students and help them excel academically. SES features include reminders & alerts, mobile app, integration with existing solution, course scheduling & administration, curriculum management, business intelligence & performance analytics, etc.

Reminders & alerts allows e-Mail notifications and SMS alerts to faculty members, students, parents, recruiters and other higher educational institutions. Mobile Apps experience via push notifications, chat, messaging. SES allows seamless integration with student information systems and e-Learning portals. The course scheduling & administration allows student records information in one-click, connected to enrollment process, evaluation, attendance, course schedules and student registration. The curriculum management is a management of education courses throughout all stages of the curriculum lifecycle from admissions, grade appeals, and change requests to graduation. The business intelligence & performance analytics offers performance & grades tracking, comparison of current class averages with historical averages.

The SES seamlessly manage student data from admission up until graduation. It enable easy access to attendance, schedules, grades, library catalogs, hostels, events and more, It make files available to any secure user from any location, It improve documents processing and security, It enable teachers to better advice and support students success, It visualize and analyze performance based on any measurable KPI and finally it increase staff and student satisfaction. Smart technologies are collaborated to create the best classroom experiences with the help of technological solutions. These solutions will have a positive impact on the educational outcomes and empower the schools positively. The educational organizations can further plan to improve their educational outcomes with the digital engagement, literacy, empowerment, collaboration, and inquiry.

3.2 Automation in Smart Education

RPA can enhance learning and improve study content. Educationa institutions can use RPA technology to design new courses, find and fill all gaps in study content based on students feedback and performances. RPA can provide automatically information to educators on predicted performance, the risk of drop-out and the possibility of reading disabilities. There are many areas within education where Chatbots and automation have potential to succeed. They are administration, interaction with end users and users queries and service requests.

- *Administration.* RPA can be used to automate all administrative repetitive tasks & non-academic activities like student registration, enrolment process, certificates & degree generation, shortlisting of candidates, students management, fee management, attendance management, email students' mark sheet, performance to parents, etc. By using RPA softwares in the administration, most of the manual labor & paperwork can be entirely eliminated. RPA can be used in Finance, Human Resources, Library etc. to replace many of their routine manual & repetitive activities.
- *Interaction with Stakeholders.* Automation software (for example Chatbot) can assist students, teachers and parents for resolution of their queries and dissemination of information. It will understand their query spoken or written, analyze & process it and provide an answer/help to them. The chatbot will offer several services to them through a conversational interface. It can take their requests, perform tasks and register concerns like a human customer executive. It also help them connect and interact with each others at any time..
- *Users' Queries and Service Requests.* Users' queries & service requests through Chatbot can be related to students, attendance, lecture schedule & time table, exam related queries (such as schedule, syllabus, result, etc.), check grades & results, tuition fees, scholarships, check availability of books at library, seek and query information from administration, send feedback about teachers, courses etc, apply for permissions, share day schedule with students, management of students & staff attendance, interact with administration and parents, academic calendar, vacation schedule, rules & regulations, campus queries, events detail announcement, alerts, suggestions, announcements & news, etc.

According to Kristina Proffitt [2018], automation can be used in smart education including e-Mail response, meeting scheduling, equipment reservations, timetable updates and social media scheduling. These automated tasks help educators more time to spend helping students and optimize their time and focus on accomplishing their academic goals.

- *Email Responses.* Auto-replies are easiest and most obvious automations to set up. Auto-replies can also benefit students.
- *Meeting Scheduling.* Automating meeting scheduling can save everyone huge amounts of time. Meeting scheduling software can be synced with everyone's schedule. It allows potential students to book their own interview time. They can factor in things like travel time when booking their interview.
- *Equipment Reservations.* Using an equipment rental software, HEIs can ensure that there is no double-bookings. Teachers can guarantee the equipment they need is available, and if they cannot find it, trace it back to the person that used it last.
- *Timetable updates.* Timetables help staff and students to work out where they need to be and when. In large locations, this can be particularly difficult to keep track of. When a location changes last minute, it can cause havoc. Syncing students' and teachers' schedules to their calendars avoids this predicament. They can also be sent a notification as soon as the change is made. This prevents them from going to the previous location, and saves them time.
- *Social media scheduling.* Many educational institutions now have social media accounts. Using scheduling tools ensures that accounts stay active no matter how busy account managers are. In the build-up to events, posts can be scheduled in advance to maximize the event's exposure weeks or even months in advance.

As a result, RPA gives teachers and administrator more time to spend on their main goal by giving students the best education possible. Students can have more time to work on their education. This can integrates formative and summative assessment processes and provide multiple stakeholders with real-time feedback about both individual learners and groups of learners.

3.3 Quality Attributes

RPA technology should consider a number of quality attributes.

- *Enterprise-class.* Educational organizations should look for tools that are built from the ground up for enterprise-grade scalability, reliability and manageability.
- *Intelligence.* The RPA tools can support simple task-based activities, read and write to any data source, and take advantage of more advanced learning to further improve automation.
- *Interoperability:* RPA Tools should work across multiple applications
- *Reliability.* As educational organizations companies launch robots to automate hundreds or even thousands of tasks, they should look for tools with built-in monitoring and analytics that enable them to monitor the health of their systems.
- *Scalability.* Educational organizations can deploy software robots to desktops or virtualized environments. They should look for RPA platforms that can be centrally managed and scale massively.
- *Simplicity.* Educational organizations should look for products that are simple enough that any employee in the business can build and use them to handle various kinds of work, including collecting data and turning content into information that enables leaders to make the best business decisions.
- *Speed.* Educational organizations should be able to design and test new robotic processes in a few hours or less, as well as optimize the bots to work quickly.

The above quality factors to enhance their capabilities and performance and boost cost savings will reportedly drive the growth of the RPA market most during that time.

3.4 RPA Business Model

RPA business model creates an automation-centric enterprise. The intelligent automation spans across physical infrastructure, business management software, operations management, analytics, process automation, AI & ML and information security, as visualized in Fig. 2. The educational organization is ready to transition into a cognitive and data-oriented model of operation. This can be done in three phases and they phases are ad-hoc phase, adoption phase and adaptive phase.

The ad-hoc phase is the perfect time for requirement gathering in educational institutions. The educational institutions should carefully evaluate how RPA could best fit into its existing technology environment, and they should come up with long-term adoption goals. Based on the gathered requirements and the RPA adoption goals, a clear automation adoption strategy is defined. The educational institutions manages to articulate its adoption goals more effectively. In adaptive phase, the educational institutions has matured in various parts of the automation strategy. They have built deep and broad automation as well as process engineering skills. With automation, capabilities built across the educational institutions and intelligent data analytics for course correction & dynamic risk management. The educational institutions have a comprehensive framework for adopting either rule-based or ML/AI-based automation, ensuring consistency and business-driven virtual workforces.

In digital learning, students have different styles of learning. Hence, it is necessary to use a variety of assistance to help increase the performance level of learning. RPA technology can be applied for allowing the virtual assistant to communicate with the students and teachers. Virtual assistants can be used by both students and teachers. Students can answer one or more virtual assistant's questions. RPA can help students to manage their teamwork project. A student is provided with the feedback about his/her progress. The teacher can monitor the progress of each student through feedback. This facilitates appropriate grading automatically. RPA can help to design presentations for specific learners. This can allow to compute a favorable learning style for each student. The teacher can able to identify which students need extra help using the feedback provided by the system. RPA can enhance learning by providing additional reference materials to a topic.

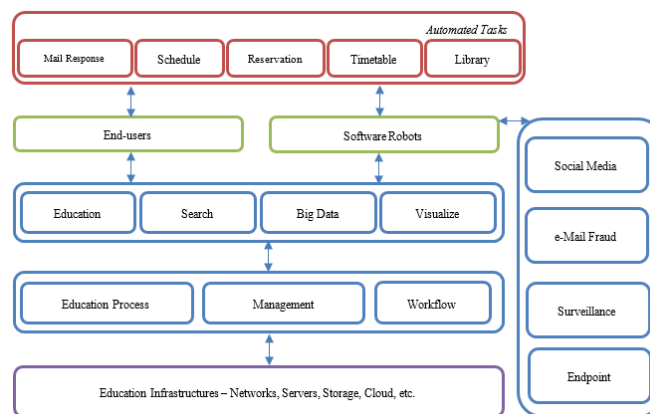


Fig. 2. RPA Business Model to Smart Education

The RPA implementation methodology includes planning, development, testing and support & maintenance phases. The planning phase identifies processes, which educators want to automate. The development phase start developing the automation workflows as per agreed plan. The testing phase run testing cycles for in-scope automation to identify and correct defects. Finally, the support & maintenance phase provide continuous support after going live and helps in immediate defect resolution. RPA is indeed a catalyst for innovation and revolution in the education sector. The advantages of RPA in the education sector are *reduced expenditure, increased productivity, and improved work execution*. Performance excellence can help the institutions to improve their overall work execution, helping them make more profits. Novel RPA applications designed to benefit the education community are explore below:

- Active learning can adaptively select assessments and other learning resources for each student individually.
- Automation in education improve the learning process and knowledge retention.
- Content analytics optimize content items like assessments, textbook sections, lecture videos, etc.
- Grading systems can assess and score student responses at large scale, either automatically or via peer grading.
- Learning analytics provide computerized and personalized feedback on learning the students' progress and their teachers.

- Scheduling algorithms search for an optimal and adapted teaching policy that helps students learn more efficiently.

IV. RESULTS

It is analyzed the selected articles and revealed interest in technologies had grown exponentially in education sector. The review focused on RPA in education whereas cutting edge works in engineering, design, and technology. It is focused predominately on technological innovation and the contribution. Technologies are enhancing productivity and innovation by automating data management and analysis in smart education. They reduce costs and increasing resources. They support decision-making by analyzing large volumes of data from multiple sources. They provide intelligence tutoring systems that are highly personalized and adaptive to needs and external changes. Intelligent tutoring systems that mimic the one-on-one interaction between tutor and student can provide highly individualized teaching programs for students.

RPA solves automation challenges and pushing educational organizations to grow into digital workplaces [8]. RPA combined with traditional content services and business process management technologies can help educational organizations reach even greater potentials and make the most of their of automation strategies. It optimizes end-to-end automation initiatives and enable teachers and educational administrators to be more efficient in handling one-off projects. This automation helps to reduce costs and increase productivity.

Use Cases. According to Van Niekerk, Poole [26], RPA enabled the university to improve the experience for students, and eliminate time-consuming tasks for staff members, providing them more time to focus on human-oriented services. Staff members at the University of Auckland were in a favorable position to notice demand changes for business process management and automation. As one of the top universities in the world, the institution offers services for more than 40,000 students, supported by 5,500 staff members. The university's multi-faceted RPA initiative started with the automation of certain internal processes, through the help of UiPath and PwC, including workflow automation and data digitization.

V. CONCLUSION

Emerging technology trends related to digital transformation, such as AI, the IoT and Big Data analytics have profound implications in terms of the skills required for the evolving digital economy. Modern technologies exist to streamline and speed operations activities of education by way of automation. The modern technologies will be more efficient in automating education activities and help bring down costs and improve productivity. Automation stands to give students added freedom and access through 'self-service' environments. Automation's impact in education will continue to augment the way staff and faculty work and improve how students engage and learn. RPA technology can noticeably transform the way educational institutions work in the modern era. It reduces the workload on the staff and teachers. It allows them to focus on teaching and creative decision making. It can reduce the gaps that the educational institutions face when it comes to excelling in the field of management with technology.

The research article reviewed the various tasks to be automated in the education sector. The reviews included various modern technologies and recent RPA. This article identified various tasks to be automated and introduced RPA technology with RPA model. In future, it is proposed to introduce RPA architecture to smart education that can improve the quality of education.

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