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# INTERCONNECTED MODERN HIGHER EDUCATION IN INDONESIA BASED ON SOA

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**ABSTRACT**

The adoption of Service Oriented Architecture (SOA) in modern higher education will help to solve the problems of adaptability by reducing integration complexity of new systems, reusing services, interoperability and increasing the agility of learning system. Furthermore, share services and cloud computing solutions could helped modern higher education and universities to create low costs and efficient service management by collaboration and open environment. The creation off interconnected modern higher education ecosystem has become an important way for players in the field of education. This paper is to propose SOA adoption solutions for universities and education institutions by modelling and designing the interconnected modern higher education's system. The aim is to create a new educational environment where learners have digital course and information accessible easily to support their educational and career goals. On the other hand, the solution is to understand the way universities and education institution solved demands complexity of the digital learning system by reducing investment costs. Moreover, we are purposing new alternatives of the architecture systems that focused on interoperability and cross-platform functionality in order to deal with high level components diversity.

**Keywords**: *Service Oriented Architecture SOA, Interconnected Modern Higher Education, Universities, E-Learning.*

## 1. INTRODUCTION

The study dealing with the definition of development, especially the concept of 'good change', argues that by understanding the role of education in development, will increase some of limitations of the nation in the of globalization era [1]. Digital campus is the target for information construction at higher education institutions. With the growing acumen of college information applications, remote island information issues and remote island applications become more and more serious has spawned the realization of information systems in universities based on SOA Architecture [2]. The emergence of Service Oriented Architecture (SOA) enables the adoption of increasingly complex IT systems, so effective monitoring becomes a trivial task. Therefore, modern education need a concept of adaptive monitoring that driven by objectives, and capable of performing dynamic management of the monitoring process in accordance with the demands of system administrators and the changing conditions of the execution environment [3]. Indonesia Higher Education System has many unique challenges associated with connected education, integrating business and academic processes and technologies. Opportunities for interconnection, integration, data, innovation, transition, communication, and collaboration is the Key to Dealing With Digital Disruption in higher education

The evolution of delivering knowledge and education process has bound to technological revolution. The practices and processes of education have transformed into different approach. Learning distance, Computer Based Training (CBT), CD-ROM are the several forms of delivery in education [4]. Moreover, the invention of internet has important role to transform the forms. There were

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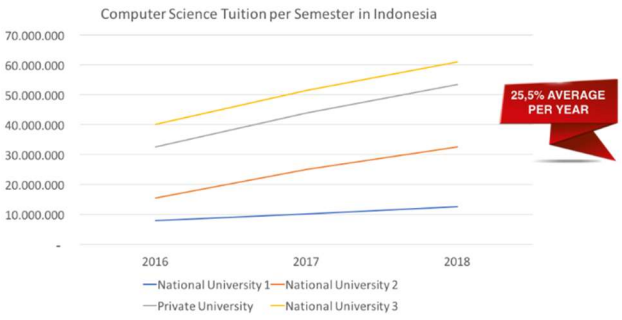
two classic case from old forms of delivering knowledge and education process, cost and time. It hampered the process of learning.

Cost of education increasing up high without doubt. The adult students have to think about affordable tuition options to attend universities. According to data collection from three best national universities and one private university where focused on computer science faculty, the tuition is rising up high every year. Figure 1 explains the tuition climb up into 25,5% per year. Compared to Indonesia's inflation in 2017, January 2, 2018 Data said the inflation rate for 2017 was 3.61% at the press conference. It is pathetic that the tuition fee of education in Indonesia is towering up high than the inflation.

A lots of effort had been made to replace conventional-one-way learning systems to modern and effective and efficient learning systems. Education systems in Indonesia are experiencing rapid development in line with internet technology. One of learning systems in education by using internet media is e-learning. Educational institutions such as schools, training providers/institutions, and universities have implemented e-learning systems as their media to students.




*Source: Processed data by team.*
*Figure 1: Tuition cost of computer science faculty per Semester*

The learner/student can possibly learn from anywhere and anytime. The level of accessibility is open to have course in remote area or in their place and less budget constraints within updated materials knowledge and qualified instructors [5]. This transformation in education is expected to create an effective and efficient learning. Based on [6], the university's business in an age of expansive change must shift from simply transferring knowledge to provide an access of the latest knowledge through digital platforms and developing and guiding potential skills. It can encourage student to research and urge the boundaries. So, we believe that the existing e-learning are not integrate to the dynamic of the globalization era. Even though the lucrative option through e-learning has been affordable, for some people who would like to learn will became an issue. Now, the bank and modern financial institution such *fintech* (peer-to-peer lending and crowdfunding) were supported in educational purposes. They provide loans in different forms. Bank has their own education loan or education program savings. On the other hand, *fintech* can reach people who have no access to the banking. In this case, the financial institution is expected to blend and connect along with the same platform.

In advanced, one of purpose from learning is to developed skill performance. The industry demands for hiring skillful ICT background's everywhere along with the rapid of technology. In order to create opportunity, several companies are working with reputable universities to hire graduates. Conventionally, the companies made effort to advertise through the wall in university or the university send informative e-mail about the job opportunity to all students. In fact, many companies have their own title scholarship, fellowship, and grant programs. Usually, scholarship has a minimum time period for recipients to study within one or two year. On the other hand, fellowship a bit different because it's specific requirements which focuses on developing professional skills. We believe that will work, but that will effective and efficient in the dynamic futures?

Most questions arise to colleges and universities is how to integrate the best educational programs with advanced technologies and new model of learning systems. It is believed to make an effective higher education around the world. Living in hypercompetitive worlds, data must be shared among these systems to support the enterprise processes, so systems integration is a necessity [7]. The complex integration between universities, financial institutions, industries (employers and scholarships), instructors and students represents an adequate the enthusiasm in modern higher education development.

Emphasized to all above, applying Service Oriented Architecture (SOA) in modern higher education is to solve the problems of adaptability by reducing integration complexity of new systems. This paper is to propose a SOA adoption solution for universities and education institutions by modelling and designing the interconnected modern higher

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education system in Indonesia. Moreover, the aim is to create a new educational environment.

### 1.1 Challenges to Building a Modern Interconnection Education Ecosystem

However, there are many challenges that hinder the ability to build an interconnected modern education experience.

**Edge Charges** - Digital whiteboards, for example, are very expensive to place in any classroom and may not have the right content to place on them. In addition, when providing this whiteboard does not serve its purpose if the chapters of the textbook are simply photocopied onto the screen.

**Uncompleted content copying** - By digitizing content, exams, quizzes, lessons and plans, turning it into an interactive experience will reach the goal of connecting peers and experts into enhanced collaboration.

**Limited broadband access** - To achieve this we also need to improve access to broadband interconnection. This is a challenge caused by limited broadband access.

**Focus on money rather than innovation** - Just as important as reaching dollars and utilising revenue streams to provide sufficient capital, it must be fundamentally supported through innovative digital education strategies. For example, if we spend millions of dollars on a laptop or school network without implementing the right strategy, the goal of creating a collaborative and engaging experience for students will not be met.

**Global sharing and collaboration barriers** - There are barriers to global sharing and collaboration. For example, research for lesson plans and exams is often locked in a filing cabinet or on a library shelf and distributed only to students on a particular university network rather than sharing information widely across a particular educational segment in a private industry.

**Challenges with digital transformation** - Every entity in the education sector consists of individuals, and processes that follow conventional educational methods. Often the transformation process requires careful planning and gradual, iterative migration. Each iteration should be planned in such a way that when completing each step can be directly beneficial to all stakeholders and its adaptation presents a smooth learning curve.

Education is no longer something that happens between the ages of 6 and 22, and then ends. The line between the years we studied and the years we produced has blurred; To remain relevant, workers must practice non-stop. Even if educational institutions evolve and ensure newly-printed workers are ready to work, workers should continue to study throughout their lives to remain relevant. Opportunities seem unlimited to make higher education more affordable, accessible and relevant. The challenge is to embrace the extraordinary innovations that take place [8].

## 2. STATE OF THE ART

So far we consider that technology has long been a part of everyday life. We can use and consider technology as a tool and discuss it with machines, computers, and all-round electronics. The meaning of technology is very broad and depends on the role of technology itself for humans. One misuse is in the field of education. Referring to [9], the literacy education technology is one-unit, but the integration of the relationship between technology devices and activities used and technology-based technology, besides modern education system can also be interpreted as the use of digital technology education including in doing project activities with most of the configuration with devices integrated into the internet. in its current development The technology developers must issue a demand from every educational environment in order to achieve the learning objectives. All of this can be easily seen and felt from its benefits in interconnection. It is widely understood that modern higher education is the interconnection between the environment and the goals in developing education, the spirit and the curriculum. Educational institutions in modern higher education will be a data company that can be used to learn in a better way with various knowledge and knowledge in it but also in modern higher education can also be understood by them on a reciprocal basis, they will be able to uncover all their abilities with new and updated knowledge. On the other hand also modern higher education as company data can also connect or students who excel directly to employers to pursue the right interest and freedom for the right work right as well. This opportunity opens more widely for people to improve their experience using available resources. This method will bring people to get the best individuals and teams to become someone else. Therefore, it will look complicated for interconnection in modern higher education.

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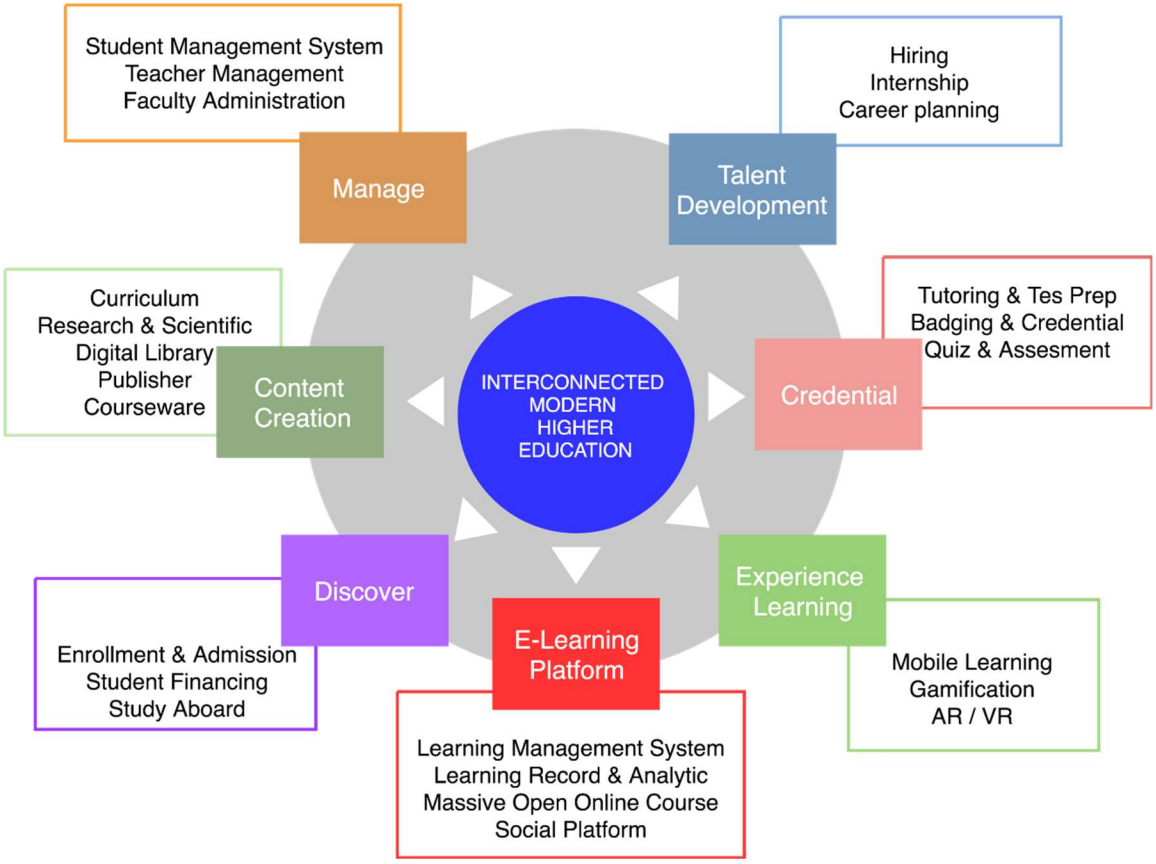


*Source: Processed data by team.*
*Figure 2: Interconnected Modern Higher Education Landscape*

Figure 2, explains that interconnected in modern higher education that needs to be encompassed by the new architecture. In the upper left is the manage, that has student management system, teacher management, and faculty administration. Below that content creation that can be plugged into a system which is curriculum, research & scientific, digital library, publisher, and courseware. Student need to discover before they choosing a course and start which include enrolment & admission, student financing for getting student loan & scholarship and if they have the plan to study aboard. The e-learning platform today exemplified by LMS, MOOC, learning record store & analytic that collected from connected systems where learning activities are conducted and social platform that connected, facilitated & interaction with, another individual. In the bellow right we have experience learning that today learning application has mobile learning, gamification, and AR/ VR (Augmented Reality & Virtual Reality). After that student need credential process in order to attest to the completion of specific training or education programs which need tutoring & test preparation, quiz & assessment and badging credential that allow student earn visual, meaningful acknowledgment of their specialized skills & interest. Finally, in the upper right, we have talent management that provides a perfect talent for employers with hiring, internship and career planning program.

Many e-learning media currently used by communities such as the learning management system Platform, LMS can be described as an integrated platform provider for content, delivery and management of learning and accessibility by various users who may include learners, content creators and administrators. In addition, there are also other E-learning media such as MOOC (Massive Open Online Course) an practically a collection of learning media from various sources connected into one in a container. Based on [10]. MOOC has been delivered using centralized platforms and services including learning management systems (LMS) and decentralized networks based on the aggregation of blog sites and

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social media feeds. MOOCs have been designed to support university curriculum, academic scholarship, community outreach, professional development, and enterprise training applications. Such e-learning media can be transferred in various ways such as mobile learning, gamification, and AR / VR (Augmented Reality & Virtual Reality).

At the end of the process the students need to gain special recognition (Certificates) from their talents and skills that have been through the training process, study guidance, tests, quizzes & assessments. And from the certificate to be one of the added values for students to survive in the world of work, but here we connect the existing talent management to join and channel the students in accordance with the criteria to follow their recruitment, internship and career planning programs.

In conjunction with experiential learning, research of social platform is growing tremendously. Said [11] social platform is a web-based technology that enables the development, deployment and management of social media solutions and services. It provides the ability to create social media websites and services with complete social media network functionality. Using social platform enables to interact with the experts and fellow learners that relied on social media network such blog, text messaging and online discussion.

Currently, most lecture/teachers are guessing to create experiential learning by combining with technologies. They believed that will make students active and enthusiastic to find and meet the global needed. Mobile learning and gamification are one of the development in experiential learning. Mobile Learning by [12]is its ability to learn in mobile, and not necessarily from the classroom. The media and devices in mobile learning are varied and updated. Mobile learning (M-Learning) provides the ability to personalize for student learning and make student passionate. M-Learning emerges as a solution to the challenges faced by education's world in order to provide convenience for lecturers and students. They can surely accessible everywhere and anywhere on many devices such as notebooks, laptop, mobile/tablets, iPad and so on. One of the causes of M-learning is acceptable by [13]:

- which are used to carry everywhere with them,
- which they regard as friendly and personal devices,
- which are cheap and easy to use,
- which they use constantly in all walks of life and in a variety of different settings, except education

The loop from all above, mobile learning is a method of learning system that make student be able to learn anywhere and anytime from the available source. On the other hand, the lecturers will have lots of learning materials from anywhere, everywhere without concerning the classroom. They can deliver the materials with fun and joyful. Another reason that can make learning more fun is to develop is by the application of gamification. the learning approach uses elements in the game or video game in order to motivate the students in the learning process and maximize the feeling of enjoyment and engagement towards the learning process [14]. in addition, other benefits of this learning media can be used to capture things that interest students and inspire them to continue to learn. In its application, the Gamification curriculum can provide students with opportunities to communicate and collaborate among their students in a technological context. The curriculum in it is created and constructed using the principles of the game in each curriculum, such as how you maintain the spirit of the students to practice without being boring and / or pressing? It takes 10,000 hours of practice to develop skills in complex tasks. On [15], gamification will help you to sort the required hours. This shows that gamification has many potential functions as a curricular template to meet competency-based education.

In the serious development of this can create new relationships between support institutions or educational activists to channel their education funds, such as for example student loans / student financing. Future reasons for high tuition will no longer be a big problem because there are institutions and facilities for students to help with the cost of education, such as LPDP and Danadidik. LPDP provides scholarship packages to promise and support tuition fees during the study period. Another company named Kitabisa.com and Danadidik adopted a crowdfunding approach to help students and funders.

Under such conditions, technology is required that allows students to use a data-driven approach to making decisions at universities. Students have the opportunity to create their own financing plans and investment benefits. It aims to improve the quality of public education and reduce the number of unemployed due to lack of qualified skills of workers who are still productive now.

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But in the financing of public education is the most important and the most important is the government's contribution to be able to lend to the community because in this case the government has more power in regulating the system of education or financing. It is important to regulate the equity of loans for students to improve the nation's economy. When the nation wants economic acceleration and industrialization in various lines but its human resources have low quality of education this will be a big problem for the government and they have to invest more for education in order to improve their society skill in education through loan. In addition, if the managerial of ineffective financing can also increase the unemployment rate educated, therefore required appropriate regulation and embrace the employers in order to join to build a prosperous society.

In contrast, Indonesian Central Bureau of Statistics (BPS) research revealed that the number of unemployed as of August 2017 amounted to 7.04 million people and pushed Indonesia to rank 77th in the Global Talents Competitiveness Index. recognizing that Indonesia is lagging Readiness of Technology (ranked 80/137) [16]. To close the skill gap of the present workforce, industry players need to overhaul the order in recruiting employees who will be their experts. Companies need to consider candidates generated by modern educational institutions as alternative educational institutions to obtain labour according to their criteria.

Jumping into the development of technology architecture in modern higher education, [17] is recommended by using service orientated architecture approach based on cloud computing. It said that technology architecture, data architecture and application architecture are the three main pillars of architecture developments. All services can be done in a centralized service for easy access, monitoring and maintenance of an e-learning system.

All services can be done in a centralized service to get an access, subscript, and maintenance systems easily. The data said that the goal is to design a service framework which meet current and future requirements of the applied system in parallel to protect the institutional investment. Also, its enabling the new function to be added gradually. Therefore, technology architecture, data architecture and application architecture are the three main pillars.

Micro-service is a common application with a series of small services that each service capable to perform by its own functions and tasks. On the other hand, SOA (Service Oriented Architecture) is an architecture with a standard application-based framework that connects and enables the systems to integrate the data which stored on different devices and sources.

In the development of modern higher education, the role of SOA is very important. It can help the industry or institution utilize their investment in IT systems which constantly updated and more complexed ecosystems. SOA diminished the complexity of new interconnected systems by reusing services and increasing the agility. Moreover [18], sharing services and cloud computing are creating a synergy and openness to the environment.

The aim of SOA is creating effective and efficient environment for students to access digital information to their long-terms goals. The advantage of using SOA in [19] are:

- Loosely coupled applications and location transparency – this allows enterprises to plug in new services or upgrade existing services with relative ease.
- Seamless connectivity of applications and interoperability – this provides opportunities to increase business agility and the ability to respond on demand.
- Alignment of IT around the needs of the business – this results in IT as the enabling technology to provide added value to business operations.
- Increased business agility, capturing new channels of business – this provides flexibility, ease of access and increased customer satisfaction.
- Enhanced reuse of existing assets and applications – this helps to reduced costs, reduced development time and a reduction of time to market
- Relatively easy integration of legacy systems – this promotes interoperability and efficient use of resources and existing facilities.
- Process-centric architecture and flexibility of approach – this allows a process driven approach, which is a worthwhile aim to achieve.
- Parallel and independent applications development – this is due to the reuse of services and ability to withdraw or plug in new developments with considerable ease.
- Better scalability and graceful evolutionary changes - this is due to the reuse of services and ability to develop applications independently and in parallel.

A serviceable, non-monolithic, service-oriented virtual learning environment based on the

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microkernel service bus design pattern and the company, can be used by teacher to create a special learning environment consisting of tools that best suit their needs [20]. To overcome the virtual Campus (VC) where users now demand more tools, more e-learning platforms, and less dependency among these platforms. To confront this requirement [21] , has defines a set of interfaces that standardize the core functions of the learning management system (LMS), thus separating the VC from the LMS and promoting its evolution toward the SaaS model.

## 3. RESEARCH METHODOLOGY

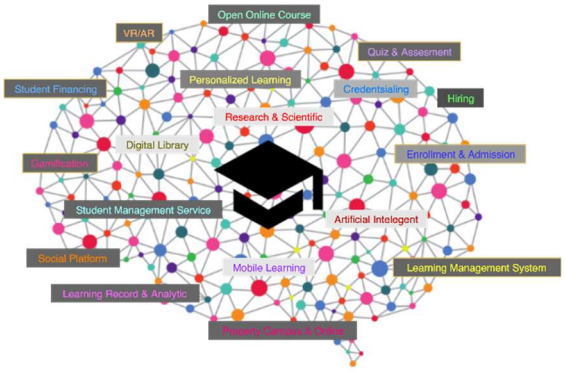
Research methodology in this study using systematic literature review, document literature, and also interview with some of users in Information Technology, Education Management, and Education Technology.

## 4. RESULT & DISCUSSION

### 4.1 Modern Higher Education Environment

Education technology begins as an idea, the idea is found anywhere and some of these ideas are developed into concepts and architecture that can make modern education environment connected, and equally excellent. There are tremendous opportunities to bridge the private industry with students and academics to take advantage of this potential innovation. Most lessons are effectively learned through action rather than learning through textbooks, which gives you simple problems to solve. Therefore, making a more project-based and more results-focused learning experience and involving brings together colleagues and experts closer. An Interconnected Modern Higher Education ecosystem helps in many ways, it prepares citizens to thrive in the global economy, helps build and inspire thoughtful thinkers and thought leaders, and instills personal ownership, responsibility, and enthusiasm. Students have the opportunity today to enhance their educational experience by utilizing the digital resources available today. The unlimited amount of internet information has changed the education itself.

This architecture starting from services, combined with internal and external application and platform in response to change in business model. Interconnected modern higher education needs a technology architecture to house the set of applications and a data architecture that will handle data and storage requirements of these applications.




*Source: Processed data by team.*
*Figure 3: Modern Higher Education Environment*

The modern higher education environment today is more complex and has many unique challenges associated with integrating new service, business and academic processes and technologies. Our complex systems are, in contrary, heterogeneous, dynamic, unbounded and composed of autonomous elements (Figure 3).

### 4.2 Interconnected Modern Higher Education landscape

Modelling and designing the new complexity in interconnected modern higher education system requires intern and alternative paradigm in system architecture. Our new architecture will need to be able to deal with the modern education key features to complex engineered systems. Firstly, it will need to be focused on services, over the properties of components. It will also need to be focused on interoperability and cross-platform functionality, to deal with high level of diversity between components. It needs to be flexible, distributed and, what we call loosely coupled and can deal with the overwhelming complexity of these systems. The services can become interconnected with each other, empowering greater connectivity and others platform, thus improving the potential of the architecture in modern higher education. The structure and makeup of complex engineered systems is fundamentally different to that of our traditional integration education & learning systems which are homogeneous, well-bounded, monolithic and relatively static. In this paper, we are proposing to use Service Oriented Architecture in interconnected modern higher education. It is used to integrate widely divergent components, by providing them with a common interface and a set of

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protocols for them to communicate through what is called a service bus. The solution framework to integrating and design a scalable reference architecture to interconnected modern higher education using Service-oriented architecture (SOA) is an approach for distributed systems architecture that employs loosely coupled services, standard interfaces, and protocols, to deliver seamless cross-platform integration. Imagine if we want to build a new web application that allows a student in university to pay different online course from the institution and another online course provider. Well, it can spend years developing a subsystem that functions as a student management system and then another subsystem for dealing with the payments, and yet another for login, user authentication and so on. Or I could simply avail of single sign-on service to use a login, student management system, a payment gateway service from payment gateway company. Our job then would be to integrate these diverse services by creating some common process that guides the user through the use of these diverse services to deliver the desired functionality. Thus, instead of building a system that was based around all my different internal components within my well-bounded piece of software, our new application would instead be built with an architecture that is oriented around services with a service-oriented architecture.

#### 4.2.1 Data Bus

A very important aspect when creating a interconnected higher education system is to digitize the content and make it available as a service. When data has been exposed as the service makes it more reusable and allows the system to easily connect with them. Sometimes content is available in digital formats, such as digital libraries, immersive content, information, course information, and other content residing in the content repository and documents stored in digital storage. Thus, this content must be visualized and available as a service via a data bus.

#### 4.2.2 Service Bus

Another important element is enterprise service bus pattern that is widely used to separate the complexity of the integration of the business services layer. The link between them is mediated by Enterprise Service Bus (ESB) which according to the concept is not a product, but an architectural best practice for implementing a service-oriented architecture [22] and it behaves. This complexity, can support multiple protocols, message formats, and messaging patterns with middleware integration, so application and service developers can concentrate on their core requirements that are specific to the business domain.This decoupling enables them to accelerate service and application creation by allowing them to adopt shorter iterative cycles. In addition to bridging the gap and meeting impedance mismatches in different systems, the company's service bus offers the value built on top of it, thus, enabling the company to expose new services in the future and to be able to collect and manage more detailed services in a coordinated way and transacted.

#### 4.2.3 Service Hosting and Frameworks

Another element is having a solid hosting platform combined with an efficient framework and a set of tools that enable quick service creation. To achieve this goal, we can adopt a MICROSERVICE approach that allows us to more efficiently create services and deploy them. In MICROSERVICE architecture, the service scope is very detailed compared to monolithic services, thus allowing independent teams to create services and enabling a more agile approach to building solutions. Because services are not tightly coupled, this architecture also offers the ability to make major modifications and improvements without affecting other services.

#### 4.2.4 Security Gateway

In the Interconnected Modern Higher Education system, there are a large number of users who need to be provided in a shorter span of time and their confidentiality and roles need to be revised throughout their academic careers. These accounts will be created as guest accounts and then raised to a more permanent account. This user can have the ability to use the same account on all systems or perform a single sign-on and can perform in a multi-factor authentication and link to their social accounts to their profile as well.

#### 4.2.5 Messaging

In an Interconnected Modern Higher Education system, we also need to support message channels that allow people, systems, and devices to communicate asynchronously. Given that connected users from remote areas will have challenges with internet connectivity, it is important to provide guaranteed message delivery while the architecture should have support for message exchange patterns such as pub / sub and message queues. In addition, with the advent of mobile devices and the Internet of things, middleware should be able to support lightweight protocols, such as MQTT.

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#### 4.2.6 API Gateway

API gateways provide managed and secure access to APIs in Interconnected Modern Higher Education. Which allows potential application developers to search, browse, and find APIs that meet functionality and can innovative connectivity, they will explore ways to increase reuse. Portals that provide vendor-driven API publisher interfaces can provide efficiency for communities and app developers to provide APIs. It should also provide them with feedback on API usage and any comments or comments that may be owned by API consumers. The API gateway and management capability might be a common resource across the enterprise. It is "decentralized" in the sense that application teams can self-publish APIs, and equally self-subscribe to the APIs they need, without needing an extra team. You can gain the benefits of standardized mechanisms for traffic management and monitoring, logging, auditing, and security in a standardized way throughout the enterprise, while retaining the agility required by the business [10].

#### 4.2.7 Application Gateway

Some applications that are specifically developed or linked from other resources that provide various services to students also need to be managed so that they are effectively utilized. This app can be a web app, a mobile app or even a desktop app that needs to be categorized and organized so that each group can easily find relevant apps. Users should also be able to perform single sign-on on this app, which they will serve; on the other hand, administrators must have the ability to limit and control the visibility and usage of the application, be able to monitor the usage of the application, and have the ability to manage the application lifecycle.

#### 4.2.8 Device Management

Current technological advances have encouraged students to increasingly use mobile devices. These devices range from smartphones, tablet PCs to laptops, which are used as a gateway to the web as well as their source of information and for social activities. The device also provides the means to manage offline content, especially giving students the option to download content when they have network connectivity and then access it when needed. Web Application Desktop and mobile using the open web (HTML, JavaScript) client programming models that are make limited to no devices specific functionality. Mobile Web Application Mobile only using open web (HTML5, JavaScript) client programming models allowing Off-line capabilities. Hybrid/Hybrid Mix Mobile Application Mobile only, the app runs on the device, but leverages open web (HTML5, JS) via JavaScript bridge Native device capabilities (GPS, camera, contacts) Mimic native appearance, the hybrid mix can have web code with native for things like navigation for maximizing user experience. Native Mobile Application Mobile only, developed using native languages or transcode to native via MAP tools, that's allowing native appearance and device capabilities, performance.

#### 4.2.9 Data Analytics and Event Processing

Other important components are large data analytics and real-time event processing capabilities adding another dimension to interconnected modern education, providing insight into content analysis that organizes and optimizes content modules, analytic learning that tracks student knowledge and recommends next steps, a scoring system that assesses and assess student responses to assessments and some back office needs as well as other big data strategies.

#### 4.2.10 Service Registry

The services are becoming fairly robust now, and the institution as a whole is getting a lot of value from the architecture, so the institution decides to expose the services to other institutions. With this new, broader user base, they decide to place overall quality of service requirements on services, including establishing downtime limits during new version deployments. They also recognize that these service endpoints may change over time, so the institution creates a service registry and imposes discoverability requirements on all services to ensure that users can find the services into the future [23].

This architecture consists of the building blocks of analytical framework required by modern interconnected educational systems. The batch processing capability can be built on Apache Spark, an open source cluster computing framework for large-scale data processing. This can be scaled to handle the large volumes of data generated by the connected educational system. As discussed above and further illustrated in Figure 4, The Interconnected Education Framework provides a complete solution architecture that fits well into reference model for interconnected reference architecture. It is a very powerful platform that can be used to solve the problems and build an interconnected education ecosystem.

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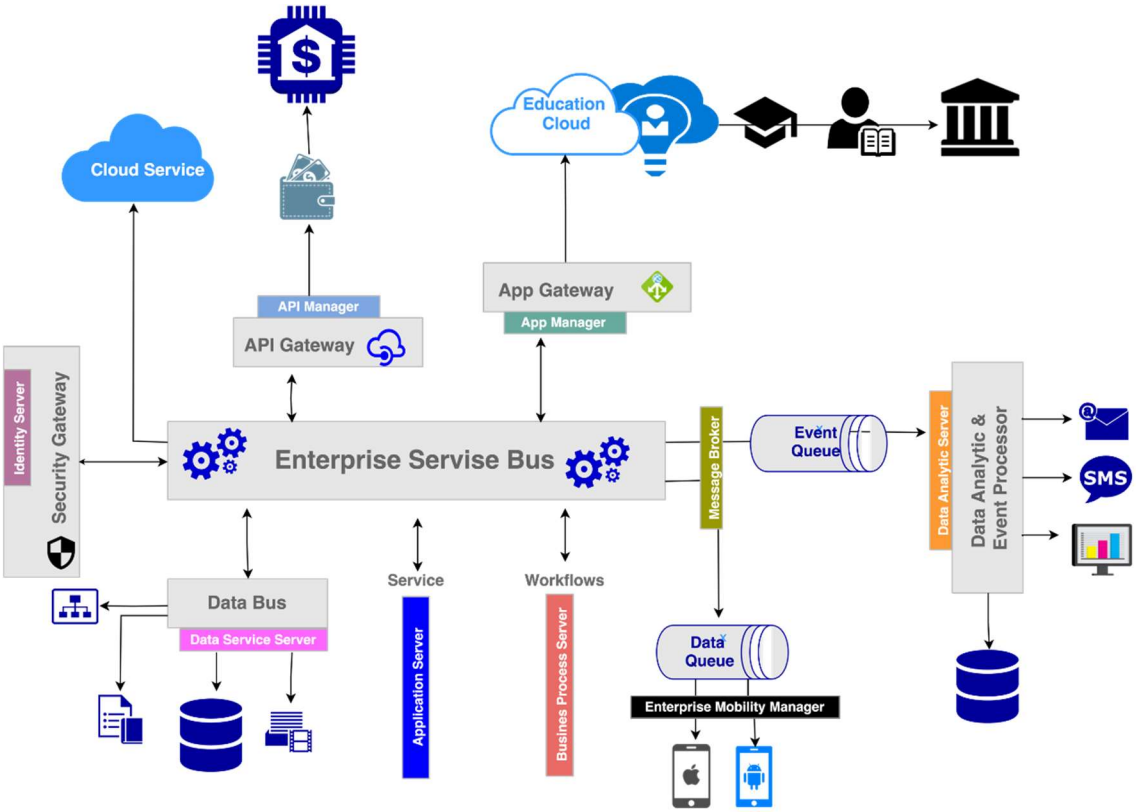


*Source: Processed data by team.*
*Figure 4: Interconnected Education Framework*

## 5. CONCLUSION

The educational space has evolved over the years marked by increasing dependence on technology to ensure efficiency and speed. Already occurred. Information systems and technologies are used to share knowledge and enable students, educators, and researchers to access information. An interconnected modern educational framework represents a unique requirement. The complex integration of universities, financial institutions, industries (entrepreneurs and scholars), instructors and students, to optimally support research projects, curriculum development, low tuition and an effective learning environment requires comprehensive solutions. In this study, more powerful tools have been made available to solve Indonesia's educational problems as part of the new educational environment and learning experience. Thus, there are tremendous opportunities to bridge the private industry with students and academics to take advantage of potential benefits. Most lesson are effectively learned through action rather than learning through textbooks, which gives you simple problems to solve. Therefore, making a more project-based and more results-focused learning experience and involving brings together colleagues and experts closer. An interconnected modern educational framework helps in many ways; it prepares citizens to thrive in the global economy, helping to build and inspire constructive thinkers and leaders of thought, and instill ownership, responsibility, and personal spirit. Students have the opportunity today to enhance their educational experience by utilizing the digital resources available today.

The unlimited amount of internet information has changed the education itself. While Google is reliable, most of the time it gives us the information we need, but it also has information inaccuracies. Thus, we can find solutions that provide factually accurate information to students.

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Technology has completely changed the way education works today. Both students and educators are increasingly looking for faster, more efficient, and effective ways to offer and access information.

This solution architecture, will give a new digital experience for students and education stakeholders, a new education experience, provides a complete product stack that fits content exchange, multipoint integration and education context info outcomes data. It is a very powerful platform that can be used to build an interconnected education framework. Education Institutions as a data company, tracking students continuously in order to improve learning and truly understand the need of individual and help them to achieve skill performance as well as sending high performance students' data to employers and to make sure provide the right talent. Students have the opportunity today to improve their educational experiences by making use of the digital resources available today. This is true learning that makes people performers, and teams that make people drivers of innovation happens when people are with people.

Thus, the creation of an interconnected modern higher education ecosystem has become an important way for players in the field of education. From the perspective of business architecture, there needs to be a seamlessly connected platform that will offer valuable services to different stakeholders, enabling them to fully utilize the benefits of such a system. From a technical perspective, to get the above business architecture in place, some technical entities need to unite. These segregations on operational aspects to unite these entities will form the building blocks of a connected educational architecture. Further research requires an overall framework, which sets all technical requirements, provides a complete product stack that matches this reference model to the various fields of reference architecture that are connected.

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