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Application of Social Networking and Cloud-Based Services to Smart Education

Rotimi-Williams Bello, Jackson Akpojaro

Department of Mathematical Sciences, University of Africa, Toru-Orua, Bayelsa State, Nigeria

Email- sirbrw@yahoo.com, jakpojaro@yahoo.com

Abstract– SMART education also known as Virtual Learning Environment (VLE) is the abbreviation for Self-directed, Motivated, Adaptive, Resource-enriched, and Technologies-embedded (SMART) education. This SMART education is not SMART device education, but rather an educational paradigm shift for digital natives. Social networking and cloud-based services such as Facebook, WhatsApp, Twitter, Slideshare, Office Web Apps, Sky Drive, Google Drive, Office 365 and many more promote students' communication and collaboration skills which are important to the 21st century education. But many education institutions do not understand how germane the application of these technologies is to the classroom to promote students' communication and collaboration skills which are important to the 21st century education. The only option left to face the challenges confronting the preparation and delivering of contents-rich academic curriculum in the 21st century by educators is the application of these technologies. The understanding of the use of these devices, applications, and services do not only help students know how to manage their abilities and careers for good purpose but assists educators as communication facilitator, collaboration coordinator, challenge promoter and mistake acceptor. Presented in this paper is application of social networking and cloud-based services to SMART education. Teaching/learning tools involving hardware and software technologies for SMART education were revealed to enhance classroom and outside classroom communication and collaboration. Findings show that students and educators were perplexed by the fact that they could use their mobile devices in the class for academic purpose because to them, smartphones are just for calling, texting, watching movies, listening to songs, playing games, and chatting. They realized the importance of social networking and cloud-based activities to their schoolwork.

Keywords– Smart education; Smartphones; Facebook; WhatsApp; Twitter; Office 365; Students; Educators.

I. INTRODUCTION

The term cloud-based services generally refer to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human interventions. There is, however, no single, universal definition. The concept of combining computers, sensors, and networks to monitor and control devices has existed for decades. Cloud-based services can be compared to cyber-physical system; a new generation of systems with integrated computational and physical capabilities that can interact with humans through many new modalities [1]. The ability to have a networked of physical devices embedded with electronics, software, sensors, actuators and connectivity which enables the physical devices to connect and exchange data, creating opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions is a key technological debate. The recent confluence of several technology market trends, however, is bringing the cloud-based services closer to widespread reality.

These include ubiquitous connectivity, widespread adoption of IP-based networking, computing economics, miniaturization, advances in data analytics, and the rise of Internet of Things (IoT) computing. IoT implementations use different technical communications models (device-to-device, device-to-cloud, device-to-gateway, and back-end data-sharing). These models highlight the flexibility in the ways that IoT devices can connect and provide value to the user, each with its own characteristics. Despite a shared belief in the potential of IoT, industry leaders and consumers are facing barriers to adopt IoT technology more widely. Among the barriers is the desire to have IoT hardware and software components that are highly interoperable, dependable, reconfigurable, and in many applications, certifiable [1]. Many social networking applications such as Facebook, WhatsApp, Twitter, Slideshare, and Office 365 depend on the cloud-based computing and IoT technologies which are the bedrock for SMART education. The understanding of the use of these devices, applications, and services do not only help students know how to manage their abilities and careers for good purpose but assists educators as communication facilitator, collaboration coordinator, challenge promoter and mistake acceptor.

II. RELATED WORK

In [2], a virtual learning environment (VLE) in educational technology is a web-based platform for the digital aspects of courses of study, usually within educational institutions [Fig. 2.1]. According to [3], VLE platforms commonly allows (1) content management for creation, storage, access to and use of learning resources (2) curriculum mapping and planning for lesson planning, assessment and personalization of the learning experience (3) learner engagement and administration for managing access to learner information and resources and tracking of progress and achievement (4) real time communication for live video conferencing or audio conferencing. A VLE is normally not designed for a specific course or subject, but is capable of supporting multiple courses over the full range of the academic program, giving a consistent interface within the institution and to some degree with other institutions using the system. The VLE supports an exchange of information between a user and the learning institute he or she is currently enrolled in through digital mediums like e-mail, chat rooms, web 2.0 sites or a forum thereby helping convey information to any part of the world with just a single click [4].

One of the processes to enhance the learning experience was the virtual resource room, which is student centered, works in a self-paced format, and which encourages students to take responsibility for their own learning. In virtual mode, the materials are available in the form of computer aided learning program, lecture notes, special self-assessment module. Another mechanism for student to student interaction in a form of simple discussion forum is by using a novel link cyber tutor. This allows the students with an email account to connect with course content and the staff with their doubts and related questions.

a **b**

Fig. 2.1. Virtual learning environment (a) and non-virtual learning environment (b)
Source: Internet

The students are able to contact the staff without a face to face visit which saves the on campus time. The staff remains anonymous which allows for the several staff to act as a cyber tutor during the course. The students do not remain anonymous although their email addresses are cryptic enough to mask their identity. Students can discuss about the exams, lab reports, posters, lectures, and technical help with downloading materials. The evaluation of the use of virtual resource room is done by surveys, focus groups and online feedback forms. The students have 24 hours of access to the learning materials in a day which suits their life styles [5-6]. VLE typically allows (1) participants to be organized into cohorts, groups and roles (2) present resources, activities and interactions within a course structure provide for the different stages of assessment (3) report on participation; and have some level of integration with other institutional systems [7-8]. For those who edit them, VLE may have a de facto role as authoring and design environments [9]. In another version of definitions, VLE is a set of teaching and learning tools in form of SMART education, which involve social networking and cloud-based services such as Facebook, WhatsApp, Twitter, Slideshare, Office 365 and many more including computers and the internet, which is used to improve the learning process of students. Some of the things that are likely to be found in a VLE are (1) curriculum material that the educator has uploaded for the students (e.g. notes, slides from presentations, multimedia materials such as quizzes) (2) discussion forum or bulletin boards, so learners can post messages and educators and other learners can reply to them (3) file space for students to store their own work (4) internet links to outside resources such as exam board material, revision websites (5) chatrooms where students can enter and chat about their work or educators can hold tutorials (6) messaging so that students can see if other students or educators are online to ask them a question or talk about their work (7) online assessment where the students can take assessment which can be marked by the computer.

There are some components required for the best VLE or SMART education curriculum to take place [1]. Some of these components include real time communication, content management, curriculum mapping and planning etc. (Fig. 2.2). But the controversies surrounding VLE have for a long time overwhelmed its justifications; this has made the acceptance of VLE very difficult.

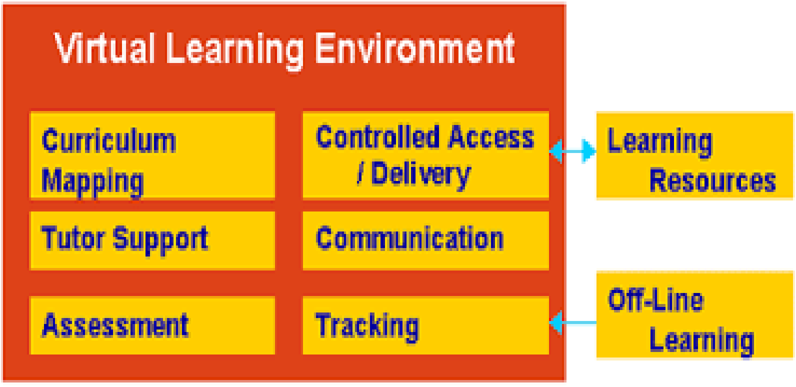

Fig. 2.2. Components of virtual learning environment
Source: Internet

In the midst of the race across the world to transform educational systems into 21st century learning environment (cle), that does not necessarily mean that one has to leverage technology to do so. According to keengwe and Gergina [10], "technology is not a substitute for good instruction". The 21st cle makes it possible for students to acquire skills demanded by the new knowledge economy [11]. Absence of these skills further widens the digital divide gap [12]. Eventually nations regress to be colonized in the web of digital divide by those who possess these skills. Table 2.1 shows some of the current and new innovation brought by the technology in our education system [13].

Table 2.1: Current and Emerging Modern 21st Century Learning Environment [13]

FIRST ORDER INNOVATIONS	SECOND ORDER INNOVATIONS
Blogs and Wikis	Augmented reality
Social networking sites	Simulations
Virtual learning environments	Digital games
Personal computers, tablets, smartphones	Console games
Interactive whiteboards	Remote response systems
Web applications	Mobile computing

First order innovations in Table 2.1 refer to common 21st cle while second order innovations refer to the emerging 21st cle. Many of the first order innovations belong to Web 2.0 technology, a term used to represent internet tools that allow transfer of 21st century skills such as communication and collaboration [13]. According to Boholano [14], 21st cle allows collaboration between teams or individual students everywhere around the world who never meet face to face. Video-conferencing as 21st cle supports collaboration [15]. 21st cle supports a combination of learning that can be described as hybrid or blended learning [16]. Students can learn by engaging in on-site classes, off-site classes or a mix of both modes. According to Keppell, Souter, and Riddle [12], 21st cle addresses the limitations of traditional teaching and learning environments which tend to be physical and characterized by mortal and bricks buildings. In these environments students are passive receivers of information from educators relying on prescribed textbook most of the time. Utilizing networked mobile equipment, people can both access and add to a developing information base, they can capture, alter and distribute sound, video and pictures from anywhere and whenever, and by including their voice, they can impact worldwide discussions [17].

III. MODERN TOOLS FOR SMART EDUCATION

Teaching and learning tools for SMART education are meant to enhance engagement, communication and collaboration of educators and students. The tools are divided into the following two categories:

- Software: Including social networking and cloud services applications such as Facebook, WhatsApp, Twitter, Slideshare, YouTube, Moviemaker, Office Web Apps, Sky Drive, Google Drive, Office 365, and so on.
- Hardware: Including IoT devices, computers and mobile devices such as communications models and smartphones.

3.1 Microsoft Office 365 for SMART Education

Microsoft Office 365 is considered as the best tool for SMART education in the sense that Exchange, SharePoint, and Lync Server in the past had to be separately installed and a lot of time spent on their administration. Now, with Office 365, no one needs to have special administrative talents before SMART education is set up for use. Students and educators are eligible for Office 365 education, which includes Word, Excel, PowerPoint, OneNote, and now Microsoft Teams, plus additional classroom tools. It can be collaborated on all devices and platforms; curriculum can be built with familiar applications and always accessible files that updates in real time. Office 365 education works on android, iOS or Windows devices.

Teams is a digital hub that brings conversations, content, and apps together in one place. Teams helps educators to create collaborative classrooms, connect in professional learning communities, and communicate with school staff all from a single experience in Office 365 education. OneNote helps in organizing class materials and prepare assignments with handwritten text, web content, even audio and video from the educators' and students' devices; then, easily collaborate with one another. Office 365 helps in SMART education in the sense that small or large teams can be invited to work with the educator at the same time within Word, Excel, or Power Point 2016 or Office online. Easy add, respond to, and tracking of all updates in a single version of document are also some of the important features of Office 365 to SMART education. Students, regardless of age or ability can personalize their studies to improve reading skills by reducing visual crowding, highlighting and voicing text, and breaking words into syllables. Use of Office 365 in the classroom for SMART education enables students learn a suite of skills and applications that employers value most highly.

3.2 IoT/Cloud-Based Services for SMART Education

IoT definition has worked out due to convergence of artificial intelligence, cyber physical systems, machine learning, and embedded systems, etc. The basic communications models of IoT demonstrate the underlying design strategies used to allow IoT devices to communicate. Aside from some technical considerations, the use of these models is largely influenced by the open versus proprietary nature of the IoT devices being networked. In the case of the device-to-gateway model, its primary feature is its ability to overcome proprietary device restrictions in connecting IoT devices. This means that device interoperability and open standards are key considerations in the design and development of internetworked IoT systems. From a general user perspective, these communications models help illustrate the ability of networked devices to add value to the end user. By enabling the user to achieve better access to an IoT device and its data, the overall value of the device is amplified. Often, however these devices use protocols like Bluetooth, Z-Wave, or ZigBee to establish direct device-to-device communications, as shown in Fig. 3.1.

These device-to-device networks allow devices that adhere to a particular communication protocol to communicate and exchange messages to achieve their function. This communications model is commonly used in applications like home automation systems, which typically use small data packets of information to communicate between devices with relatively low data rate requirements. Residential IoT devices like light bulbs, light switches, thermostats, and door locks normally send small amounts of information to each other in a home automation scenario. This device-to-device communications approach illustrates many of the interoperability challenges. These devices often have a direct relationship, they usually have built-in security and trust mechanisms, but they also use device-specific data models that require redundant development efforts by device manufacturers [18]. This means that the device manufacturers need to invest in development efforts to implement device-specific data formats rather than open approaches that enable use of standard data formats.

Fig. 3.1. Device-to-device communications model
Source: Internet

In a device-to-cloud communications model (Fig.3.2), the IoT device connects directly to an internet cloud service like an application service provider to exchange data and control message traffic. This approach frequently takes advantage of existing communications mechanisms like traditional wired Ethernet or Wi-Fi connections to establish a connection between the device and the IP network, which ultimately connects to the cloud service. This communications model is employed by some popular consumer IoT devices like the Nest Labs Learning Thermostat and the Samsung SmartTV. In the case of the Nest Learning Thermostat, the device transmits data to a cloud database where the data can be used to analyze home energy consumption.

Fig. 3.2. Device-to-cloud communications model
Source: Internet

The device-to-cloud model adds value to the end user by extending the capabilities of the device beyond its native features. However, interoperability challenges can arise when attempting to integrate devices made by different manufacturers. Frequently, the device and cloud service are from the same vendor. If proprietary data protocols are used between the device and the cloud service, the device owner or user may be tied to a specific cloud service, limiting or preventing the use of alternative service providers. This is commonly referred to as "vendor lock-in'', a term that encompasses other facets of the relationship with the provider such as ownership of and access to the data. At the same time, users can generally have confidence that devices designed for the specific platform can be integrated.

In the device-to-gateway model, or more typically, the device-to application-layer gateway (ALG) model, the IoT device connects through an ALG service as a conduit to reach a cloud service. In simpler terms, this means that there is application software operating on a local gateway device, which acts as an intermediary between the device and the cloud service and provides security and other functionality such as data or protocol translation. The model is shown in Fig. 3.3. Several forms of this model are found in consumer devices. In many cases, the local gateway device is a smart phone running an app to communicate with a device and relay data to a cloud service. This is often the model employed with popular consumer items like personal fitness trackers. These devices do not have the native ability to connect directly to a cloud service, so they frequently rely on smart phone app software to serve as an intermediary gateway to connect the fitness device to the cloud.

The other form of this device-to-gateway model is the emergence of "hub" devices in home automation applications. These are devices that serve as a local gateway between individual IoT devices and a cloud service, but they can also bridge the interoperability gap between devices themselves. For example, the Smart Things hub is a stand-alone gateway device that has Z-Wave and Zigbee transceivers installed to communicate with both families of devices. It then connects to the Smart Things cloud service, allowing the user to gain access to the devices using a smart phone app and an internet connection. This communications model is used in situations where the smart objects require interoperability with non-IP (Internet Protocol) devices. Sometimes this approach is taken for integrating IPv6-only devices, which means a gateway is necessary for legacy IPv4-only devices and services. In other words, this communications model is frequently used to integrate new smart devices into a legacy system with devices that are not natively interoperable with them. A downside of this approach is that the necessary development of the application-layer gateway software and system adds complexity and cost to the overall system.

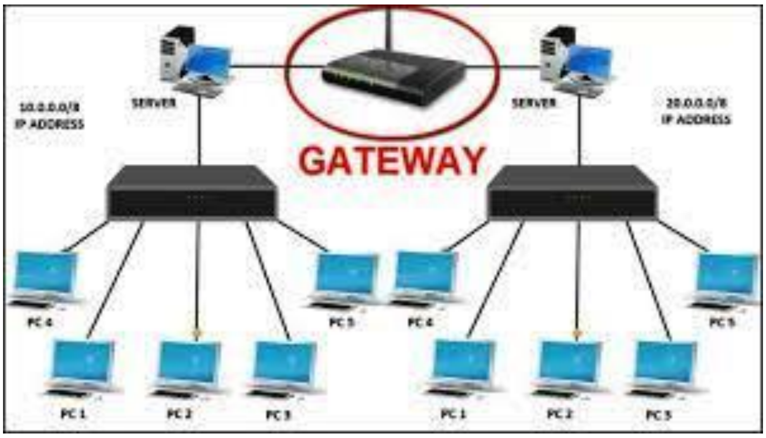

Fig. 3.3. Device-to-gateway communications model
Source: Internet

The back-end data-sharing model refers to a communication architecture that enables users to export and analyze smart object data from a cloud service in combination with data from other sources. This architecture supports "the user's desire for granting access to the uploaded sensor data to third parties". This approach is an extension of the single device-to-cloud communications model, which can lead to data silos where "IoT devices upload data only to a single application service provider''. A back-end sharing architecture allows the data collected from single IoT device data streams to be aggregated and analyzed as shown in Fig. 3.4. Effective back-end data-sharing architectures allow users to move their data when they switch between IoT services, breaking down traditional data silo barriers. The back-end data-sharing model suggests a federated cloud services approach or cloud applications programmer interfaces (APIs) are needed to achieve interoperability of smart device data hosted in the cloud. This architecture model is an approach to achieve interoperability among these back-end systems. "Standard protocols can help but are not sufficient to eliminate data silos because common information models are needed between the vendors." In other words, this communications model is only as effective as the underlying IoT system designs. Back-end data sharing architectures cannot fully overcome closed system designs.

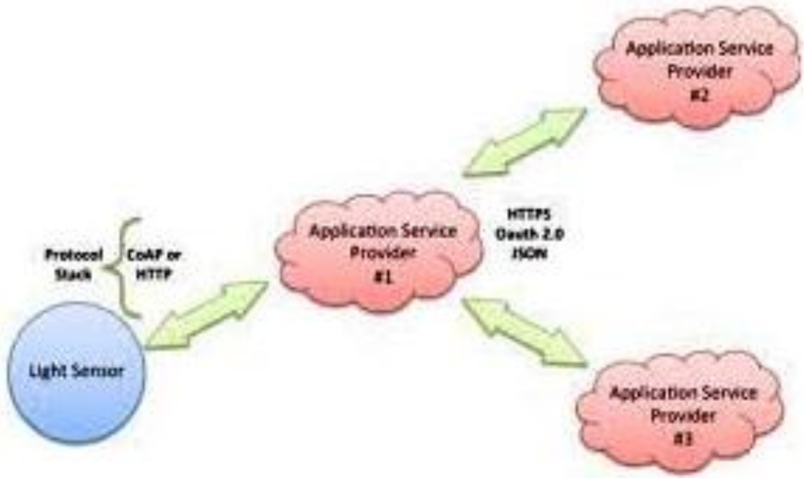

Fig. 3.4. Back-end data-sharing communications model
Source: Internet

IV. CHALLENGES OF SMART EDUCATION

Lack of access to stable electricity, internet, and the devices needed for SMART education can pose a threat to the acceptability of SMART education over the traditional method of education. The following are some notable challenges of SMART education. First, devices and applications always change, and we probably do not have much time to guarantee their usefulness in the class. Making a manual on selecting new technologies for school is very good. Second, students who have learned from technically outstanding educators are different from other students who have not. Educators that are not technologically trained and inclined cannot have knowledge needed about communication and collaboration in 21century education. In fact, most educators are not digital natives, so they are nervous about the use of technologies (especially mobile devices and apps). Today, many educators and students use social networking and cloud-based services such as Facebook, Twitter, Slideshare, Office365, etc., but they do not seem to fully understand how to apply these tools to their classroom to promote students' communication and collaboration skills which are essential to the 21st century. As noted in the principles that guide SMART education, ensuring the security, reliability, resilience, and stability of internet applications and services is critical to promoting trust and use of the internet. As users of the internet, we need to have a high degree of trust that the internet, its applications, and the devices linked to it are secure enough to do the kinds of activities we want to do online in relation to the risk tolerance associated with those activities. IoT is no different in this respect, and security in IoT is fundamentally linked to the ability of users to trust their environment. If people don't believe their connected devices and their information are reasonably secure from misuse or harm, the resulting erosion of trust causes a reluctance to use the internet. This has global consequences to SMART education, technical innovation, free speech, and practically every other aspect of online activities. Indeed, ensuring security in IoT products and services should be considered a top priority for the sector.

As we increasingly connect devices to the internet, new opportunities to exploit potential security vulnerabilities grow. Poorly secured IoT devices could serve as entry points for cyber attack by allowing malicious individuals to re-program a device or cause it to malfunction. Poorly designed devices can expose user data to theft by leaving data streams inadequately protected. Failing or malfunctioning devices also can create security vulnerabilities. These problems are just as large or larger for the small, cheap, and ubiquitous smart devices in the IoT as they are for the computers that have traditionally been the endpoints of internet connectivity. Competitive cost and technical constraints on IoT devices challenge manufacturers to adequately design security features into these devices, potentially creating security and long-term maintainability vulnerabilities greater than their traditional computer counterparts. Along with potential security design deficiencies, the sheer increase in the number and nature of IoT devices could increase the opportunities of attack. When coupled with the highly interconnected nature of IoT devices, every poorly secured device that is connected online potentially affects the security and resilience of the internet globally, not just locally. To complicate matters, our ability to function in our daily activities without using devices or systems that are internet-enabled is likely to decrease in a hyper connected world. In fact, it is increasingly difficult to purchase some devices that are not internet-connected because certain vendors only make connected products.

Day by day, we become more connected and dependent on IoT devices for essential services, and we need the devices to be secure, while recognizing that no device can be absolutely secure. This increasing level of dependence on IoT devices and the internet services they interact with also increases the pathways for wrongdoers to gain access to devices. This is why security of IoT devices and services is a major discussion point and should be considered a critical issue. We increasingly depend on these devices for essential services, and their behavior may have global reach and impact. Innovative approaches to abstraction and architectures that enable seamless integration of control, communication, and computation must be developed for rapid design and deployment of IoT. For example, in communication networks, interfaces have been standardized between different layers. Once these interfaces have been established, the modularity allows specialized developments in each layer. The overall design allows heterogeneous systems to be composed in plug-and-play fashion, opening opportunities for innovation and massive proliferation of technology and the development of the internet. However, the existing science and engineering base do not support routine, efficient, robust, modular design and development of IoT. Standardized abstractions and architectures are urgently needed to fully support integration and interoperability and spur similar innovations in IoT [19].

V. CONCLUSION

The objective of this paper is to reveal how social networking and cloud-based services can be applied to SMART education. This was achieved, as it was iterated in this paper that, through technologies, classroom activities can be extended to the real world. In the past, students' seeing, hearing, and feeling were limited to only the classroom, but now, students can go beyond their classroom by using mobile devices as hardware, virtual reality as software, and the internet as services, and, students communicate, exchange information and progress through collaborative learning projects with colleagues around the world [20]. Teaching/learning tools involving hardware and software technologies for SMART education were revealed to enhance classroom and outside classroom communication and collaboration. Few students and educators interacted with were perplexed by the fact that they could use their mobile devices in the class for academic purpose because to them, smartphones are just for calling, texting, watching movies, listening to songs, playing games, and chatting. They realized the importance of social networking and cloud-based activities to their schoolwork. For successful application of social networking and cloud-based services to SMART education, the followings are recommended (1) Students must know how to use their devices, applications, and services for good purpose. There are no "perfect" tools – they are dependent on the user's motives and methods. (2) Device manufacturers, telecommunications, software companies, communities and governments, as well as schools, should work together to help students use devices and software properly. (3) Students must sustain their identity online and offline, those, who freely switch between online and offline, have to be balanced and use integrity in every aspect of their lives. (4) When educators prepare the teaching contents and methods, they must deeply consider their students' future.

In addition, educators should take the following roles (1) Mistake Acceptor: Until now, students have always been asked to give correct answers. But students should be allowed to make mistakes and be given enough chances to learn by themselves. When they do something on their own, they are learning something. (2) Communication Facilitator: Inside or outside of the classroom, most students want to communicate with educators and other students more actively. So, educators should help them to do that by giving proper technologies, themes, and circumstances. Especially mobile devices and web services like Office365 help to stir up the process. (3) Collaboration Coordinator: In the past, students did their own work and received their own grade. Yet, in the current working world, there is little time to work alone. They should spend most of their time to work as a team, achieve the same goals together and share the responsibilities. Collaboration skills are crucial. So educators must design the collaborative projects and teach the best way to work with other people. And an educator's role is to prepare, consult and assess on the project, rather than lead. (4) Challenge Promoter: Individuals and institutions always fear uncertainty, and want to pursue a predictable future. But in class, with a well-designed curriculum and assignment, students can face the fears in a safe environment. Creative leaders in the future will be the people who are willing to fight against the uncertainty. So educators should prepare challenging activities – from simple to difficult and complicated [20].

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