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Emerging educational technologies in higher educational institutions: The current trends and impacts from Thailand universities' perspectives

Skonchai Chanunan[a*], Department of Science Education, Faculty of Education, Naresuan University, 65000, Phitsanulok, Thailand.

Michael Bruckner[b], Department of Science Education, Faculty of Education, Naresuan University, 65000, Phitsanulok, Thailand.

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Abstract

The provision of appropriate educational technologies can be an advantage of higher education institutions in terms of marketing, or branding, and for managing and supporting students' learning. These kinds of technologies evolve rapidly, and it is therefore sensible for educational institutions to explore the impact of innovative (or emerging) technologies prior to their broad adoption by the mainstream in order to create an early competitive advantage. The purpose of this research was to examine the current trends and impacts of emerging educational technologies that are expected to be in most higher education institutions. In this research, the information extracted from the literature was collected through a scoping literature review. In addition, the Technology Hype Cycle by the Gartner group was employed for identifying the emerging key technologies for education. In addition to the literature review, the interviews were carried out as semi-structured conversations with ten university lecturers from different universities across Thailand to find out the current trends of using and impacts of emerging educational technologies on teaching, learning and creative inquiry in higher education. The results from the literature review part suggest that there are twelve emerging educational technologies which can be grouped into four sets representing the current trends in educational technology development which are: 1) multimode or multichannel technologies for learning, 2) social learning technologies, 3) cloud-based learning technologies and, 4) ICT interoperability. However, according to the results from the interviews with Thailand university lecturers, it is suggested that seven emerging educational technologies which are 1) open source learning repositories, 2) social learning platforms, 3) cloud email, 4) EMNS, 5) learning stack, 6) unified communication and collaboration technologies, and 7) student retention CRM, now have profound impacts and the impact will be more in the near future and need more development to suit their current work. From the analysis, these emerging technologies are appropriate for the context of Thai universities in terms of project budgets, manpower, and time constraints.
Keywords: Emerging educational technologies; the technology Hype-Cycle; Thailand universities' perspectives.

* ADDRESS FOR CORRESPONDENCE: **Skonchai Chanunan,** Department of Science Education, Faculty of Education, Naresuan University, 65000, Phitsanulok, Thailand.
E-mail address: chanunant@hotmail.com / Tel.: +66 5596 1000

1. Introduction

The educational market is increasingly competitive due to the globalization and internationalization of education. The Association of South East Asian Nations (ASEAN) is seeking stronger bonds through economic interdependence aiming not only at free trade but also at free choice of place of residence. The launch of the ASEAN Economic Community in 2015 and the subsequent free flow of workforce and people between the member countries will lead to internationalization in many fields, including higher education. This has been identified as a problem that has to be addressed by many institutions in Thailand, see as an example Somjai (2014) relating to Rajamangkala University of Technology Lanna (RMUTL). Another example is the establishment of the College of Logistics and Supply Chain at Naresuan University in 2011 with a clear international focus. This also leads to new challenges for the educational sector, which cannot be met by formal university education but need to be addressed through informal learning (Johnson et al., 2013). Informal learning is learning that is self-directed and in line with the student's own learning goals. Communication and critical thinking are examples of skills that are often acquired or enhanced through informal learning. Most of the digital skills students of today exhibit have been acquired through informal learning outside academia. According to informal learning in higher education, modular learning with smaller chunks of learning materials that are adaptable to the learner's needs delivered in a learning environment (not as a fixed curriculum for all students) enables further development of higher education and lifelong learning including educational institutions. As thus, emerging technologies will most likely play an important role in reaching the demands of those institutions in the 21st century. However, there are some misconceptions about emerging technologies. Some might think that they act purely as tools of education, e.g. tablet computers as being tools of teaching and learning. Indeed, many of these emerging technologies bear the capability to evolve as platforms for different ways of education, and an example of this is again the tablet computer, which enables learners to access digital learning materials on the go.

It must be pointed out that a clear-cut definition of the term emerging technology does not exist so far (Veletsianos, 2010), so we have to define the term here for the purpose of this paper. Emerging technologies are technologies including their applications currently in development and possibly being applicable to the potential user community within the next ten years. A more elaborate definition has been disclosed by Rotolo, Hicks and Martin (2015) who identified five attributes of an emerging technology: radical novelty, relatively fast growth, coherence, prominent impact, and uncertainty and ambiguity. In addition, emerging technologies are expected to change the economic and social environment in a profound way. From these descriptions and for the purpose of this paper, it can be inferred that emerging educational technologies are technologies including their applications currently in development which have not yet been widely adopted and that are expected to influence a variety of educational organizations within next ten years.

In terms of emerging educational technologies, the number of tools for the education industry seems to be growing at an increasing rate, and many new or aspiring teachers might be wondering how to incorporate current technology in classrooms. The good news is that there are entire courses and entire degree programs teaching educators exactly how to make the most of tools like iPads, laptop computers, SMART Boards, and a number of innovative software solutions that enhance the way students learn about important concepts in an international environment. Indeed, there are many other technologies emerging from various needs in societies, markets and the Research & Development community. These technologies are at different stages of development; some are close to be widely introduced to the general public (e.g., 3D scanners and 3D printers, and speech recognition), while others are merely at the horizon (e.g., affective computing, brain-computer interfaces, and Big Data for education). Whereas technology can increase the convenience of teaching and learning, it is also clear that the engagement of students is needed to produce useful outcomes of the efforts of instruction. Rising numbers of educators recognize that technology use does not automatically benefit education in any significant way. It is about how to harness technology to promote students' learning and critical inquiry. Teachers and researchers have the responsibility to discover what can be done and what is useful for their instructional attempts in terms of technology, including emerging educational

technologies. At this point, teachers or lecturers are facing challenges previously not known or not been aware of: what are the best practices for educational technologies to support their institutions' goals, which typically comprise developing critical thinking and problem solving skills as well as lifelong learning environments (Mayes, Natividad & Spector, 2015).

Different methods have been used to assess the impact of educational technologies. A range of methods is available for the analysis of future technologies. Among others, bibliometrics (scientometrics), Delphi method, surveys, agent-based modelling, social impact assessment, relevance trees, backcasting, technology roadmapping, cost-benefit analysis, and even gaming through scenario simulations have been used to discover the impact of future technologies on different areas of the society. Based on a systematic citation analysis, Kinshuk et al. (2013) found emerging educational technologies that were considered for research between 2003 and 2010, with published results in the journal *Educational Technology and Society* and highly cited. The authors concluded that the future research topics of educational technology then were mobile learning, ubiquitous learning, and game-based learning. Emerging educational technologies have been approached differently by Delgado Kloos et al. (2014), who have used a framework space with three dimensions to organize and analyze: physical-digital resources, local-global educational settings, and formal-informal learning processes. The three dimensions are independent, and, consequently, individual locations in an appropriately constructed three-dimensional model space can be used as a starting point for further research on the interdependencies of the dimensions. A quite similar approach to the one used in our study has been applied by Kaivo-Oja et al. (2014), who have considered a timeline that is by far longer than ours and lasts until 2030. They have gained results through online discussions among 48 experts and by analyzing peer reviewed literature to filter the top 100 technologies that would potentially lead to radical changes in the society (i.e., the so-called transformational technologies). Among the highest ranked technologies were the following (the asterisk points at technologies potentially useful for educational organizations):

- Open data and big data*
- Freely organizing distance work and web-based organizations*
- New forms of labor outsourcing to crowds*
- Instruments of enhanced reality*
- Gamification of co-operation and society*
- Extremely dense quantum processors
- Reorganization of learning*
- Robot cars
- Easy to produce and cheap biochips and biosensors
- 3D printing of physical objects*

1.1. The Technology Hype Cycle approach

This research has applied the technology hype cycle, which has been published by the Gartner Group now for more than 20 years. The Hype Cycle is a branded graphical tool developed by IT research and advisory company Gartner for representing the maturity, adoption and social application of specific technologies. Every year, Gartner publishes the general Hype Cycle of Emerging Technologies showing a snapshot of their developmental status; more specific hype cycles for key technologies can be received as well (see Fig. 1). As is shown in **Error! Reference source not found.**, each Hype Cycle comprises five key phases forming the life cycle of a given technology when followed over the years of reporting: Technology Trigger, Peak of Inflated Expectations, Trough of Disillusionment, Slope of Enlightenment, and Plateau of Productivity. Besides the general hype cycle of emerging technologies, Gartner also provides more specific hype cycles, and one of those is the Hype Cycle of Educational Technology. As Grundmeyer (2014) suggests, Gartner's Hype Cycle provides clear insight for school leaders as to when technology adoption is safe and value-added investment, and it can play a key role in the timing of adopting technologies in educational organizations. On the other hand, the Hype Cycle can also be used by commercial providers of educational technology to address potential gaps in the

market to bridge. The Hype Cycle has been used in various research projects, e.g. by Campani and Vaglio (2015); Laru, Näykki and Järvelä (2014); Banica (2014); O'Leary (2008); Jun (2012); and Grundmeyer (2014).

Gartner's hype cycle graphs represent the evolution of technical developments as a function of expectations based on reviews of the literature, analysis of commercial trends and expert interviews. A detailed view on the role of different actors using Gartner's Hype Cycle has been given by Jun (2012). The Technology Hype Cycles have been updated on an annual basis and enable organizations to evaluate how mature a specific technology is and whether it is the right time for adopting it, see Figure 1. As an overview, Gartner uses a standard diagram that shows the level of visibility in the general public and puts the technologies at a place within the shape. The basic assumption for the design of the hype cycle is that technologies follow a similar pattern of development until they are either obsolete before having been introduced in the mainstream or available to the public as a technology of use.

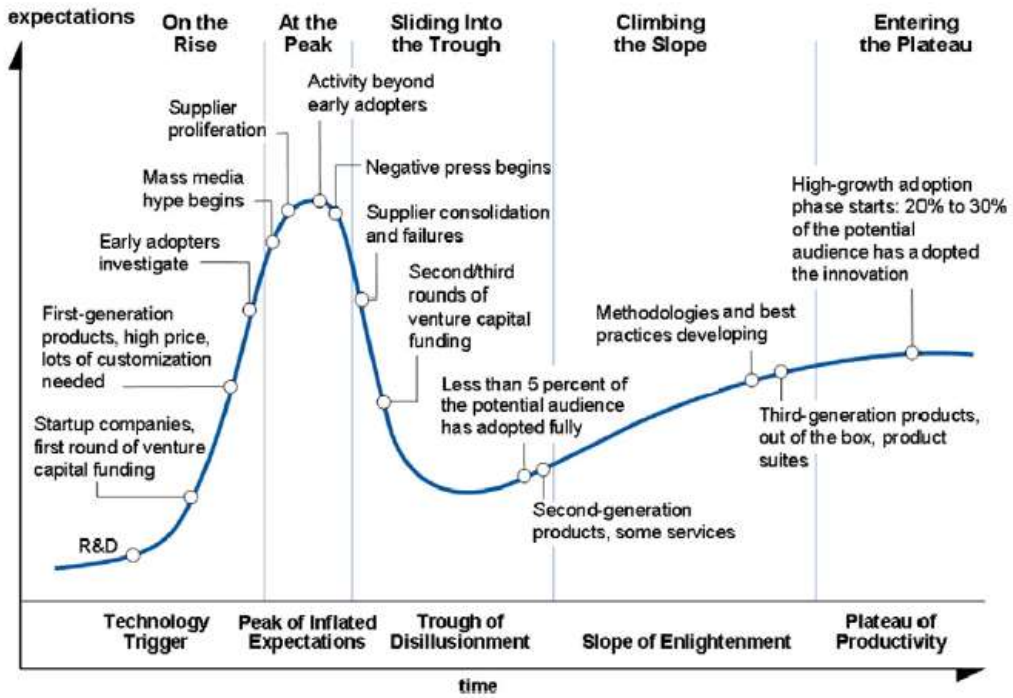

Figure 1. 2014 Hype cycle graph for emerging educational technologies (Gartner, 2014)

The explanation of each phase of Gartner's hype cycle is given in the table 1.

Table 1. Technology Hype Cycle phases and their explanation

Phase	Explanation (paraphrase)

Technology Trigger	The technology has gained interest because of a potential breakthrough. Novel stories about potential applications add to media interest, which triggers the more or less wider public interest. Because commercial viability is not clear, companies stay away from developing products and wait for more substantial research outcomes.
Peak of Inflated Expectations	Stories of success and failure emerge in the media and lead to speculations about potential applications and products (and even their consequences for the society and individuals), which are more or less based on reality. Some companies take action; most stay away. This means first products appear.
Trough of Disillusionment	Poor outcomes of experiments and first generation products do not meet the expectations of early adopters. Producers of the technology turn away or fail. Investments continue only if the surviving providers improve their products to the satisfaction of early adopters.
Slope of Enlightenment	Next-generation products from producers show the advantages, potential profitability and future prospects of usage more clearly. More enterprises understand the technological and commercial concepts and are ready to fund pilots; conservative companies remain cautious.
Plateau of Productivity	A considerable number of adopters is present, and provider capabilities are trusted by the mainstream customers. The potential of technology application and its relevance is seen more clearly.

To assess the impact of emerging technologies on educational organizations, the Technology Hype Cycle published annually by the Gartner Group has been applied in this research. It should be noted that we did not intend to build a new hype cycle format or content, rather we have harnessed the existing hype cycle provided by Gartner in 2014 to identify technologies that are beneficial for educational purposes and assess the impact of those technologies.

From the notion mentioned above, it can be summarized that the provision of appropriate educational technologies can be an advantage of higher education institutions in terms of marketing, or branding, and for managing and supporting students' learning. These kinds of technologies evolve rapidly, and it is therefore sensible for educational institutions to explore the impact of innovative (or emerging) technologies prior to their broad adoption by the mainstream in order to create an early competitive advantage.

2. Research Questions and Purposes

This research study was carried out to address to the two major questions which are: 1) which are the emerging educational technologies with potential impacts on educational institutions in Thai university lecturers' perspectives, and 2) what are the implications for other higher educational institutions in adopting some of these emerging educational technologies. From the research questions, this research aimed at investigating different emerging technologies for their potential application in educational settings (instruction, teaching, or learning). Thus, the specific purposes of the research study was to examine the current trends and impacts of emerging educational technologies that are expected to be in most higher education institutions from Thailand university lecturers' perspectives.

3. Method

In this study, a qualitative research was employed as the framework. Data collection was done through literature review and semi-structured interview. Data analysis was carried out using content analysis approach. The details for both data collection and analysis are given as follows.

For the data collection from literature review, the information extracted from the literature was collected through a scoping literature review and the Technology Hype Cycle by the Gartner group was employed for identifying the emerging key technologies for education. The qualitative review covers the literature on emerging educational technologies of the last four years and analyses. The search of the literature was performed the following way:

- Literature databases used: Springerlink, ScienceDirect, ProQuest, ERIC, Google Scholar, Emerald Insight, and EBSCOhost

- Keywords and phrases: all of the following string searches included the search terms relating the different technologies and their synonyms; the publication years covered in the search were 2010 until 2016 (including preprints)

  - Open Source Learning Repositories" / some synonyms: "open learning repositories", "open learning materials", "reusable learning materials", "open learning objects", "open educational resources", "open content" +education, "open content" +learning/teaching
  - Social Learning Platforms / some synonyms: "social learning environments", "virtual learning environments"
  - IT Infrastructure Utility / synonym: "infrastructure as a service", "iaas"
  - Cloud Email for Staff and Faculty
  - Cloud Office Systems / near term: "Software as a Service" +office (SaaS)
  - Emergency and Mass Notification Systems
  - Hosted Virtual Desktops / "desktop virtualization", "virtual desktop infrastructure", "desktop as a service"
  - Learning Stack / synonyms: "learning platform", near term: "learning tools interoperability", "context platform", "learning tool interoperability"
  - Open Source Middleware Suites (or platforms, or software) / "open source soa" (+platform or +suite or + software)
  - Student Retention CRM / "learning analytics" +retention
  - Unified Communication and Collaboration Technologies
  - Cloud HPC or Computing as a Service (CaaS) / "high performance computing" + cloud

- Criteria for the inclusion in the set of publications for further examination were: (1) indication of specific conditions in educational contexts under which the technologies will likely appear in the near future or conditions, which would considered as obstacles for their appearance, and (2) potential implications of the use of the technologies.

- Number of papers: 781 of which 73 were duplicates (or published by the same authors in separate places with minor differences regarding results), leaving 708 for further study; after the analysis of the abstracts and concluding remarks of each paper 92 studies remained for further examination.

- The remaining papers were skimmed for the existence of practical forecasts and recommendations regarding prospective educational technologies, for the geographical and organizational (educational level) setting of the study and for teaching subject(s) covered.

After the literature review process completed, interviews with university lecturers was used to explore the emerging educational technologies' current trends and impact on teaching and learning from their perspectives.

The interviews were carried out as semi-structured conversations with ten university lecturers from different universities across Thailand. Regarding the interviewees, all of the participants are from government universities, aged from 30 to 55 years, and 43.78 years on average. Their main roles within educational institutions (and relating to educational technology) are lecturers and also researchers in their fields of study. Among the ten interviewees, four female university lecturers took part in this study whereas other six were male lecturers also obtained. According to the field of the study which the lecturers are specialized in, three lecturers were obtained from faculty of science, other five lecturers were from faculty of education and last two lecturers were from faculty of engineering. Geographically, five interviewees were from universities located in the northern part of Thailand, two interviewees were from universities located in the southern part, other two from universities located in Bangkok and one from the university located in the northeastern part of Thailand. All of them have worked in universities as lecturers, and their teaching work have been related with educational technologies, especially teaching and learning and also their research work at universities. Their university teaching experience ranged from three years to twenty years, 13.46 years on average. From the data mentioned above, there might be some limitations of the study in terms of the participant number. However, the results from the interview part were intended to support the results from the literature review part. As for the purpose of the study, all the interviewees were labelled as Lecturer I, II, III, IV, V,VI, VII, VIII, IX, and X, respectively.

Since the primary perspective of data collection was the discovery of perceived benefits and drawbacks of some of the emerging educational technologies, semi-structured interviews were used as the main source for data. The ten lecturers from universities across Thailand were obtained as interviewees who were considered representatives of higher education institutions in Thailand. The interviews were carried out by the authors. The structured part was sent to the interviewees prior to the interview to give them time for preparing the interviews mostly for making them aware of the emerging technologies we were keen at eliciting data on. In the unstructured part of the interviews, the interviewees were given the opportunity to explain any ideas and perspectives about emerging educational technologies and identify those technologies that they deemed important and emerging in their respective institutions. Data form both parts were analyzed using content analysis approach. Some basic statistics were also be used.

4. Results and Discussion

The results of the study are organized as follows: first, the results of the literature study is given, which summarizes the bare essentials of the respective technologies as well as current trends and forecasts relating emerging educational technologies. Second, the results of the interviews conducted by the author regarding the technologies are presented, and finally the results are summarized. In addition, the discussion parts are presented simultaneously along with the literature results.

The results of an analysis of the literature relating emerging educational technologies are provided. As for the purpose the study, we focus on only the technologies that are expected to be available to mainstream institutions by 2020 and to have a major impact on teaching and learning according to university lecturers' perspectives.

In the presentation of the results, there are twelve emerging educational technologies which were resulted from the literature review part and these technologies have been grouped into four sets representing the current trends in educational technology development, which are

- Multimode or multichannel technologies for learning (with Student Retention CRM, Unified Communication and Collaboration, and Emergency and Mass Notification Systems (EMNS))
- Social learning technologies (Open Source Learning Repositories, Social Learning Platforms, and Learning Stack**)**
- Cloud-based learning technologies (Cloud Office Systems, Infrastructure as a Service Applications (SaaS), Cloud Email for Staff and Faculty, and Cloud High Performance Computing)

- ICT interoperability (Open Source Middleware Suites and Hosted Virtual Desktops)

From the list of the technologies mentioned, those are technologies typically directed at different user groups which are (1) instructors (teachers, professors, training personnel), (2) students, (3) technical staff (administrators, technicians) and (4) administrative staff (office assistants, regular staff). However, in this research study, our focus was put on the technologies regarding the uses of instructors (teachers, professors, and training personnel) and students in particular. Those technologies for instructors and students are 1) Open Source Learning Repositories, 2) Social Learning Platforms, 3) Cloud Email, 4) EMNS, 5) Learning Stack, 6) Unified Communication and collaboration technologies, and 7) Student Retention CRM. These seven technologies were taken into consideration and used for interviewing part of the study.

Some clarifications about emerging educational technologies mentioned previously are given. It must be mentioned that some of these technologies are based on a common infrastructure. As an example, the adoption of cloud computing in an educational organization is needed in order to harness most social learning platforms, Infrastructure as a Service, Cloud Email and Office Systems, most Hosted Virtual Desktop solutions, and Computing as a Service. If cloud computing is not available for any reason, these technologies will most likely be out of the reach to the educational organization. Applications are the APIs and other pieces of software that are used by the members of the organization (students, staff and faculty). Runtime is the environment, in which the particular application is running, including the runtime library of the functions required by the application. Middleware refers to the switching software used to contact and communicate other applications (databases and operating system functions). OS is the operating system, which is responsible for providing and managing all the functions of the computer hardware used by the applications. The hardware consists of the physical units, such as servers, CPU, storage, and the network. It may contain a virtualization layer that provides the virtualized infrastructure resources to the OS. For the seven emerging educational technologies, the results are given and coupled with discussions as follows.

4.1. Open source learning repositories

The concept of Open Source Learning Repositories is based on Open Educational Resources, a term introduced in 2002 at a conference hosted by UNESCO. "Open" in the context of educational resources is often mistakenly only understood as "free for the user or consumer" but it is more than that: open also means copyable, remixable, and accessible without any barriers to interaction (Downes, 2007). It should be clear that "free" in this sense does not mean free for the creator or provider of the resource. The UNESCO World Congress on Open Educational Resources has made access to these resources a priority (UNESCO, 2012). This is particularly important for many educational institutions in developing countries, which are typically underfunded and struggle to keep pace with institutions in the developed countries. But even there, the financial situation can be challenging, which encourages programs for increased access to open educational resources (see Marcus-Quinn and Diggins, 2012, for a case study on an institution in Ireland). Besides the objective to ease budget constraints, Open Source Learning Repositories are directed at lifelong learners and the bridging of formal, non-formal and informal learning (Mulder, 2006). Open Source Learning Repositories are curated collections of learning materials that are open source and therefore free of charge to use in educational settings. Being typically software products, a variety of formats may be used to offer the learning materials to the public, institutional members or subscribers. The content of the materials covers the whole range of educational levels, from K-12 to higher education and exhibits textual, graphical, video and computing materials, which are usually part of a Web site or Web portal. Open source learning repositories appear in many different forms: text bases, digital collections (Karadimas, Loumas & Papastamatiou, 2008), graphical collections (as published, for example, via Pinterest*) and as video collections (as published, for example, on Youtube and Vimeo). Open source learning repositories can have very different

objectives: from small scale and narrow in disciplines covered (Meneely, Williams & Gehringer, 2008), have built a repository for computer science and software engineering courses) to large scale and broad. Some examples of these are MERLOT II, OER Commons and OpenCourseWare. Higher education is also the environment, in which Massive Open Online Courses (MOOCs) have been used to some extent since around 2012. According to the interview results, Open Source Learning Repositories were welcomed by all participants. However, sharing of educational resources is not as common as it could be, even for members of the same departments. Lecturer I and II stated that the most useful repositories were open access and based on one of the Creative Commons licenses (used by the Wikimedia Foundation, among many others). Lecturer III added that "it would be useful to connect NU's e-learning platform to open access resources available on NU-NET (at Naresuan University, Thailand)." Regarding the sharing of their own resources for free, lecturer IV offered the view that "it's not sure how sustainable OERs will be, so I won't contribute much." As to the view mentioned previously, building and maintaining real Open Source Learning Repositories need a significant change of the academic culture. The current tenure process leads to the 'quasi-copyrighting' of learning materials within institutions. The major concern here is how much instructors are encouraged to share their self-produced materials openly. Open Source Learning Repositories with its free content for the user/consumer may also include free journals.

4.2. Social learning platforms

Social Learning Platforms extend the concept of Learning Management Systems (LMS) by introducing social network services in the learning (and teaching) experiences. These platforms support formal, informal as well as social learning activities. Learners interact at a 24/7 time frame, whenever and wherever they are ready to learn materials; in addition, learners create results and return their products. Social Learning Platforms can be used in many different educational settings and for many different pedagogical purposes as is outlined in the following. The two social network services that are currently used the most are Facebook and Twitter. Both services have also been widely adopted by teachers as has been studied by Ivanova (2012). The results show that teachers regard Twitter as more useful for their professional development than Facebook (acceptance rates for Twitter 35% and Facebook 6%), and the same holds true for the assessment of the importance of both services for student learning activities (Twitter is rated 70% with Facebook 51%). These findings support those previously achieved by Shih (2011). Some scholars regard Twitter less as a social network service but as a news media, although they admit social tagging is a useful feature extending traditional news media, see Kwak et al., 2010, for a discussion of this topic. Further aspects of using social learning platforms include the fostering of self-regulated learning opportunities as well as the integration of formal and informal learning (Farrow et al., 2015; Dabbagh & Kitsantas, 2012). Students can participate in knowledge generation on media they are comfortable with and cooperate in making meaning of the learning materials provided by the teacher and their peers. According to the interview results, all the participants considered social learning platforms as powerful tools for teaching and learning in their classes and some of the participants (Lectuer I, II, IV, V, and IX) stated that they now conduct research to find out their best ways to incorporate these technologies into their class uses. For learning purpose, Social Learning Platforms foster self-regulated learning in a group, which is a form of informal or non-formal learning. As such, they need learning resource repositories that are as open as possible.

4.3. Cloud email for staff and faculty

Cloud email for staff and faculty is the continuation of what has been done for students' email services (Sclater, 2012) and is typically part of Software as a Service (SaaS), which is based on Infrastructure as a Service (IaaS) and Platform as a Service (PaaS). In this case, cloud means no-fee email service and, consequently, educational organizations can save a lot of money that would otherwise go to fee-based service providers or had to be spent for internal staff to run the institution's email service. Another benefit of this type of service is that it is not only about emailing but also about new related

services, e.g. chatting, video calls and free file storage (e.g. Google Drive in conjunction with Google Mail with free cloud space of 15 GB, which includes the other services offered by Google clouds: Drive, Youtube and Blogger). Srinivasan et al. (2011) proposed a novel cloud based email service solution on top of multiple web-based free email accounts, EMFS, focusing on unique challenges and opportunities associated with utilizing email services for file transfer and storage, such as email based data organization, metadata format and management including provider-imposed handling of anti-spam usage restrictions. EMFS views email accounts as virtual disks and employs RAID-like approaches for space aggregation, data striping, and data replication. According to the interview results, all university lecturers have a cloud based email account, which is also used for institutional purposes: Gmail, Hotmail and Yahoo were mentioned. Of course, all the lecturers working with their universities also have the university based cloud email service at hand. Cloud Email for Staff and Faculty was ranked the 2nd of the seven technologies by all lecturers. As thus, this technology can be considered as one of the key tools for all lecturers for their teaching and research work. From this point, institutions should consider: (1) financial aspects (price per email user), (2) infrastructure alignment, (3) features, (4) migration effort, (5) support and Service Level Agreements, (6) security and privacy of data.

4.4. Emergency Mass Notification Services (EMNS)

Public participation in emergency response situations has surged due to increased availability of online access. Some organizations employ social media data to collect data relating cases of emergency. Emergency and mass notification systems are related to areas of the institutional administration, which have to be involved in the decision processes: facility management, physical security, fire safety, crisis management, health management, and disaster event information processing. Emergency Mass Notification Services (EMNS) disseminate and manage notification messages automatically from one sender to appropriate receivers (e.g., staff, faculty, students and parents). EMNS uses a variety of means to connect to recipients: voice, SMS, email, digital signage, public alerting systems etc. that can be accessed via Web portals, mobile phone apps, Internet browsers, interactive voice response, and the vendor's call center. EMNS are applied in case of emergency events, business operations notifications, IT service alerting and public safety. Since these systems rely on a variety of communication channels, there is some vendor overlap between EMNS and Unified Communications and Collaboration. For users of Facebook and Twitter, Namahoot and Brueckner (2015) have developed a location aware smartphone emergency and accident reporting system. The system shows users how to reach the nearest point-of-care in case of emergency or accident. This approach is a kind of passive service, where users have to get active to receive messages. Types of information that are relevant to respond to disasters include short videos, photos, text information (e.g., via blog posts and SMS). Another powerful source for communications and social integration of data is Twitter, and its use has been analyzed in disaster communication (Dugdale, Van de Walle & Koeppinghoff, 2012). EMNSs should be able to accurately handle those types of information fast and securely (Yates and Paquette, 2011). Reliable decision making needs also location-aware services for security staff, police, Emergency Medical Services, and firefighters, which are typically based on smartphone apps (Namahoot & Brückner, 2015). According to the interview results, the participants in the interviews contributed to this topic in a more episodic way by bringing up examples of emergency situations and accidents at their respective workplaces. Emergency and Mass Notification Systems were considered as the low important and irrelevant technologies by all participants in the prioritization task. (This is probably due to the fact that the responsibility for these systems is usually with the administrative staff; in addition, many participants may have felt that the notifications distributed regularly by the 'Webmaster' are sufficient for a working emergency and mass notification system. From the interviews, it can be concluded that the relatively low important technologies of this feature among the participants indicates that users do not feel a particular need for this kind of system. This might be caused by the overall availability of such communication services as 4G, WiFi and others.

4.5. Learning stack

The concept of learning stack is not easy to track in the literature because it is used in a variety of contexts: educational technology, machine learning (Boohsheri & Luksch, 2014) and different psychological levels of individual learning*. In contrast to the following broad definition, the term Learning Stack has also been used with a rather narrow meaning as the construction of various hypertext media, which represent explicit connections between conceptions (for this use of the term teaching mathematical concepts, see Lloyd and Wilson, 2001). Regarding educational technology, a Learning Stack can be interpreted as a collection of educational elements accessible under a context platform, which enables tool interoperability. The elements can be content repositories, social learning platforms, teacher and student portfolios, personal productivity tools or office systems, educational cloud services, data sources as well as learning apps, among many others. These components represent a vast mixture of elements in terms of complexity and amount of data included. The elements of the Learning Stack can be delivered by updates, removed, added and replaced with the help of the context platform. The tool interoperability is a critical criterion for building the Learning Stack because interoperability enables the use of certain tools in a variety of Learning Management Systems (LMS) that are used by higher learning institutions nowadays (Alier et al., 2012). Of course, tool interoperability for the learning stack means the setting and compliance of common standards, e.g. the LTI or SimpleLTI, which are used by the middleware connecting the tools at the e-learning platform. From the interview results, the learning stack was considered less important by the university lecturers. This can be suggested that institutions that have already set up such Web application suites as Google Apps for Education and Office 365 should consider their role within the learning stack (Gartner, 2014). They also should favor open structures of learning platforms and their potential for building context platforms following standards, e.g. Caliper. External tools and services that students and faculty have used successfully should be included in the learning stack to extend the range of useful teaching and learning applications for both instructors and students. The expectation regarding learning stacks including context platforms is that students will use the learning stack to get access to more diverse learning materials bottom-up, i.e. they start with definitions of important concepts, apply them, and then go on with advanced learning materials according to the learning context. Faculty members would be freed from continuously directing students' learning activities. According to the interview, there were two interviewees (Lecturer IX, X) actually responding to the questions of the questionnaire regarding this educational technology. Both of them indicated the need for interoperability of the various components, which a context platform might be built on. In addition, interoperability would also mean the setting and application of standards in the development, delivery and use of the components of the learning stack. , Lecturer IX, offered some thought on this by asking: "Do we have to reorganize or even rebuild our learning tools when we have to use learning stacks?" Mentioning Moodle as a kind of learning stack, she continued: "I don't see the context building with Moodle, it's just a system for gathering course materials by hand and point the students to." As a result, this can be suggested that institutions that have already set up such Web application suites as Google Apps for Education and Office 365 should consider their role within the learning stack (Gartner, 2014). They also should favor open structures of learning platforms and their potential for building context platforms following standards, e.g. Caliper. External tools and services that students and faculty have used successfully should be included in the learning stack to extend the range of useful teaching and learning applications for both instructors and students. The expectation regarding learning stacks including context platforms is that students will use the learning stack to get access to more diverse learning materials bottom-up, i.e. they start with definitions of important concepts, apply them, and then go on with advanced learning materials according to the learning context. Faculty members would be freed from continuously directing students' learning activities.

4.6. Unified communication and collaboration technologies

Unified Communications and Collaboration combines different telephony, messaging, voice, video and networking technologies. These technologies are aimed at improving personal productivity, groupware and social learning applications. The blending of different technologies, typically from

different vendors, causes integration problems but offers the opportunity of consistent user interfaces on different communication and collaboration tools. End users, i.e. teachers, students and staff, may start with instant messaging and then want to go on with video conferencing with the desired participants on mobile devices and computers. This requires the institution to set up a combined staffing model for communication and networking infrastructure following the objectives of collaborative and productive working structures. Nowadays, mobile apps are used to set up such structures, and since Gartner's analysis (2014) many applications have increasingly been used to reach these goals, e.g. the Line Application, particularly among communities in Asia including ASEAN countries. Besides Web portal services, video conferencing, instant messaging, texting, calendar management, presence information (for students, instructors and staff), chatting, call control, speech recognition and phone calls, the integration of social technology will be an area of interest to enhance teaching, learning and collaboration for research. To leverage the hardware typically used by students (Android devices, iPhones, tablet computers, netbooks and notebook computers), Griffith University has introduced jPoll, an application for the classroom. Instructors create lists of questions in varying sets that they wish to poll students' knowledge on. During class students are directed to a website which can be bookmarked for later use and enter in a question set identifier. Questions that are enabled can be answered and results are shown in the administration section of jPoll. These responses can be shown in various ways to give both the instructor and the students an overview of what was entered. So, both parties get a sense of understanding of the instructional content, and the instructor can react by clarifying confusing concepts and adjusting the pace of the lecture. According to the interview results, almost all participants expect a lot of benefits from unified communication and collaboration. The top requirement is the 'unified' user interface for all the communication tasks that are mostly carried out over IP networks. Regarding the unified collaboration technology section, lecturer II, III, VI and X mentioned the use of services like Google Hangouts, which comes near this requirement by offering video conferencing, collaborative live document generation and sharing, and integrated production via Google Drive services. Regarding the unified communication part, lecturer VI commented: "I work with my colleagues through the Line Application. I can leave them short messages, reminders; also I can send links of important and useful information I have found on the Web. But most effectively is the feature of sending files, PDFs, Word files, everything. Colleagues can pick them up at their desktops and work with those files." This works because most researchers, instructors and students are always online and use the BYOD strategy (Bring Your Own Device) on campus and at home. Although many benefits of Unified Communication and Collaboration Technologies are easily identified, the quantification of such benefits through a cost-benefit-analysis may be more complicated. Faster problem solving, higher awareness of information needs and their resolution, and wider access to various internal and external information resources have to be quantified, among others. As thus, institutions should bear in mind potential information security issues regarding the use of Unified Communication and Collaboration Technologies as with all mobile technologies. They should consider setting up strict policies for the communication and collaboration processes.

4.7. Student Retention CRM

Student Retention CRM (Customer Relationship Management) comprises components for identifying and contacting students that are at risk of dropping out of higher education programs. The components also cover such tasks as improvement planning, tracking and assessment of measures for successful interventions if necessary. Student Retention CRM is used in the middle of students' life cycle at higher education institutions, following Student Enrollment CRM (when new students are recruited) and followed by Alumni CRM (after students have graduated). Collecting and using data from various sources for the assessment of competencies and knowledge is a complex task, which needs a structured approach for bringing the data into the correct format (as for example in the data warehouse approach). Rayon, Guenaga and Nunez (2014) describe a platform for student data aggregated through social media analytics, which supports interoperability of the tools used for data collection. The platform

extracts both trace data of how users interact with the resources and the platform and how users interact among themselves (students and instructors). Much deeper insights are expected from employing natural language processing tools to social media (Wen, Yang and Rose, 2014). According to the interviews, one lecturer (Lecturer VII) took the following view: "we need a wider view on data related to the individual student, which does not only focus on academic performance but also on such social data as accommodation use and library access, for example". Another lecturer (Lecturer VIII) was more concerned with the privacy of the data gained this way: "In the same way, we store administrative student data within our Intranet we should also keep their performance data safe there." Student retention CRM was considered at the middle level of their importance by all participants of the prioritization task. Gartner (2014) describes the interest by administrators to track reasons why students leave an institution and to gather appropriate data for CRM solutions and further analysis ('learning analytics'). Unfortunately, we did not have the opportunity to interview a participant from the administrative staff during this research. It can be suggested that institutions should look for flexible solutions with user-defined alerting functions, triggers and data analytics including open APIs that can be integrated with existing campus software and external data sources.

In summary, from the twelve emerging educational technologies, there are seven technologies regarding university lecturers' teaching and research work: Open Source Learning Repositories, Social Learning Platforms, Cloud Email, EMNS, Learning Stack, Unified Communication and collaboration technologies, and Student Retention CRM. These technologies have their impacts on university lecturers' work differently in terms of availability and usability. Some technologies are most welcomed and considered as key tools for teaching and learning by the university lecturers, such as Social Learning Platforms, Unified Communication and Collaboration Technologies, Open Source Learning Repositories, Cloud Email. However, some technologies are overlooked and considered as less important tools for their work. Some technologies are currently in uses and have positive impacts on the university lecturers' work.

5. Conclusion and Recommendations

This research study aimed at gaining insight into the current trends and impacts of emerging educational technologies on higher educational institutions in Thailand. The major data in this study were generated by a thorough review of the literature and by carrying out interviews with ten university lecturers across Thailand. From using Gartner's hype cycle (Gartner, 2014), it was found that there are twelve emerging educational technologies and these technologies have been grouped into four sets representing the current trends in educational technology development, which are

- Multimode or multichannel technologies for learning (with Student Retention CRM, Unified Communication and Collaboration, and Emergency and Mass Notification Systems (EMNS)
- Social learning technologies (Open Source Learning Repositories, Social Learning Platforms, and Learning Stack**)**
- Cloud-based learning technologies (Cloud Office Systems, Infrastructure as a Service Applications (SaaS), Cloud Email for Staff and Faculty, and Cloud High Performance Computing)
- ICT interoperability (Open Source Middleware Suites and Hosted Virtual Desktops)

From the twelve emerging educational technologies, there are seven technologies regarding university lecturers' teaching and research work, namely, Open Source Learning Repositories, Social Learning Platforms, Cloud Email, EMNS, Learning Stack, Unified Communication and collaboration technologies, and Student Retention CRM. These technologies have their impacts on university lecturers' work differently in terms of availability and usability. Some technologies are most welcomed and considered as key tools for teaching and learning by the university lecturers, such as Social Learning Platforms, Unified Communication and Collaboration Technologies, Open Source Learning Repositories, Cloud Email. However, some technologies are overlooked and considered as less important tools for their work. Some technologies are currently in uses and already have positive impacts on the university lecturers' work. From the results of the study, it might be suggested that the degree of adoption of any

educational technology is based on a number of criteria and regarding individual higher educational institutions, appropriate evaluation and audit processes will certainly benefit the planning of value-added emerging technologies that fit the institutions. As Tabrizi and Farahsa (2015) have concluded in their systematic review of evaluation and audit in individual higher education institutions, the evaluation criteria, procedures and indicators should be student centered and reflect the organizational values and mission. In a similar direction, Veletsianos (2010) argues that emergent technologies are context-specific: what is emerging in one context or region may not be considered emerging in another. Employing emerging technologies to further educational goals may necessitate the development of different theories, pedagogies, and approaches to teaching, learning, assessment, and institutions.

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