MODELING OF SUBSTITUTION AUGMENTATION MODIFICATION
REDEFINITION IN ACADEMIC INFORMATION SYSTEM EDUCATION 3.0:
A CASE STUDY OF SISTEM INFORMASI AKADEMIK,
UNIVERSITAS LANGLANGBUANA

HADI PRASETYO UTOMO

A thesis submitted in
fulfillment of the requirement for the award of the
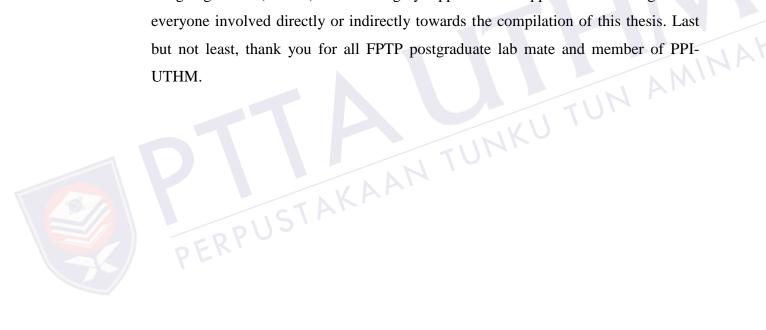Doctor of Philosophy in Technology Management

Faculty of Technology Management and Business
Universiti Tun Hussein Onn Malaysia

August 2021

Alhamdulillah to Allah subhanahu wa ta'ala. For my beloved wife, Widi Pangestuty, mother, father. Thank you for your support.

ACKNOWLEDGEMENTS

ABSTRACT

The emergence of Education 3.0 as a new paradigm in education has been spread widely in many educational institutions, especially in higher education institutions (HEIs). Many of them have been implementing Education 3.0, such as socially constructed, technology-oriented, and mobile learning. However, the implementation caused some problems. The new procedures are causing administrative problems, especially in the academic affair (e.g., redundant administrative works, late to submit final marks). The problems also mentioned the mobile access issue. Some information and functionalities missed when accessing the academic information system (AIS) from the mobile device. Moreover, the implementation also needs to provide external involvement (parents and industry). The academic information system (AIS) can be used to support the characteristics of Education 3.0. The information system (IS) components possibly related to the characteristics of Education 3.0. The first phase of this research used a case study of Sistem Informasi Akademik, Universitas Langlangbuana to conduct qualitative research with a semi-structured interview. A case study is beneficial in researching issues related to the institutional systems. The second phase is model development as an outcome. This research found that all the characteristics of Education 3.0 can support by the AIS. This research also found that administrative problems can be solved by integrating existing AIS with e-learning. The integrated AIS must support mobile platforms and also support parents and industry involvement. The platform issue must be concerned for future development. To accommodate all issues above, the existing AIS must transform by following a specific guide. A model needs to guide the transformation, and Substitution Augmentation Modification Redefinition (SAMR) framework used for modeling. A model called SAMR-AIS-Edu3.0 has been developed based on the research findings. The model has been validated with the data triangulation method.

ABSTRAK

Kemunculan Education 3.0 sebagai paradigma baru dalam pendidikan telah tersebar luas di banyak institusi pendidikan, terutama di institusi pendidikan tinggi (IPT). Kebanyakan mereka telah melaksanakan ciri-ciri daripada Education 3.0 seperti dibina secara social, berorientasikan teknologi, dan pembelajaran mudah alih. Bagaimanapun, pelaksanaannya menyebabkan beberapa masalah. Peraturan baru ini menyebabkan timbulnya masalah pentadbiran, khususnya dalam bidang akademik seperti pertindihan kerja-kerja pentadbiran dan kelewatan menyerahkan keputusan akhir. Ia juga membangkitkan isu akses mudah alih. Selain itu, pelaksanaannya juga perlu menyediakan penglibatan luar seperti ibu bapa dan industri. Untuk mengatasi masalah ini, Sistem Maklumat Akademik (SMA) boleh digunakan untuk menyokong ciri-ciri Education 3.0. Komponen sistem maklumat (SM) boleh dikaitkan dengan ciri-ciri Education 3.0. Fasa pertama kajian ini menggunakan kajian kes sebagai kaedah dan melakukan penyelidikan kualitatif dengan wawancara separa berstruktur. Kes yang digunakan adalah Sistem Maklumat Akademik, Universitas Langlangbuana. Fasa kedua adalah pembangunan model sebagai hasil fasa pertama. Kajian ini mendapati bahawa semua ciri-ciri Education 3.0 boleh disokong oleh SMA. Kajian ini juga mendapati masalah pentadbiran dapat diselesaikan dengan mengintegrasikan SMA sedia ada dengan e-learning. SMA bersepadu mesti menyokong platform mudah alih, dan juga menyokong penglibatan ibu bapa dan industri. Isu platform mesti diberi perhatian untuk pembangunan SMA di masa hadapan. Untuk menampung semua ciri-ciri baru di atas, SMA sedia ada perlu diubah dengan mengikuti panduan tertentu. Sebuah model perlu membimbing transformasi, dan rangka kerja Substitution Augmentation Modification Redefinition (SAMR) digunakan untuk pemodelan. Model yang dipanggil SAMR-AIS-Edu3.0 telah dibangunkan berdasarkan penemuan penyelidikan. Model ini telah disahkan dengan kaedah triangulasi data.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AIS	-	Academic Information System
BAN-PT	-	Badan Akreditasi Nasional Perguruan Tinggi
HEI	-	Higher Education Institution
HR	-	Human Resource
ICT	-	Information and Communication Technology
IS	-	Information System
LMS	-	Learning Management System
MDA	-	Model-Driven Architecture
OMG	-	Open Management Group
SAMR	-	Substitution Augmentation Modification Redefinition
SIAk	-	Sistem Informasi Akademik
SOA	-	Service-Oriented Architecture
UML	-	Unified Modeling Language
UNLA	-	Universitas Langlangbuana

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Research background

Information and communication technology (ICT) has become an important tool in the modern management of higher education institutions (HEIs). This is because information is a critical tool in facilitating management decisions and therefore, ICT is seen to be a crucial tool to help in facilitating acquisition of this information required in management decisions for institutions (Bøe, Gulbrandsen & Sørebø, 2015 and Agrawal & Mittal, 2018).

Usages of ICT in the management of higher education institutions include but not limited to (1) academic affairs, (2) financial and accounting affairs, (3) inventory and procurement affairs and (4) general affairs (Krishnaveni & Meenakumari, 2010). ICT has helped academic staff in the major areas of upgrading of knowledge, research, and publication (Archibong & Effiom, 2009 and Lubis, Idrus & Sarji, 2018). Use of ICT in the management of academic affairs is the most important of the whole institution management. Therefore, many institutions have been build academic information system (AIS) based on ICT to support their academic affairs management (Indrayani, 2013). These AIS not only support administrative process but also can support the learning process.

Nowadays, there is a paradigm in education called Education 3.0. In Education 3.0, students are empowered to produce, not merely to consume the knowledge (Harkins, 2008). It is characterized by openness and the obsolescence of

physical and perceived barriers in the learning environment. Social networking plays a tremendous role allowing students to collaboratively create and share in learning artifacts. The student is required to make new choices with the abundance of information available to them. The student is therefore seen as a producer and collaborator in the generation of content (Keats & Schmidt, 2007).

Educational systems around the world are realizing the potential of an Education 3.0 (and beyond), leveraged by technology, to increase personalization and improve outcomes. Personalized learning encompasses numerous components to support individualization, differentiation, and supporting each student's interests and motivation. These components may be philosophical, pedagogical, structural, or rooted in policy. Each may be implemented and evaluated individually, in combined initiatives, or an integrated whole (Twyman, 2014).

In addition, the behavior and habit of new students are very much different from what they used to be. The new kind of education must capitalize this behavior and must able to produce innovative entrepreneur graduates. The answer is Education 3.0 where the students are given a wide open opportunity to learn by themselves, to innovate, collaborate, experiment and explore all possibilities. In short, Education 3.0 is empowering the learning to the students (Rahmat & Osman, 2012). The characteristics of Education 3.0 are given in Table 1.1.

Table 1.1: The characteristics of Education 3.0

(Moravec, 2008)

Characteristic	Education 3.0
Meaning is …	Socially constructed and contextually reinvented knowledge
Technology is …	Everywhere (digital natives in a digital universe) for ubiquitous knowledge construction and transmission
Lecturing is done …	Lecturer to student, student to student, student to lecturer, people-technology-people (co-construction of knowledge)
Institutions are located …	Everywhere in the "creative society" (thoroughly infused into society: cafes, bowling alleys, bars)
Parents view education institutions as …	Places for students to create knowledge, and for which parents may provide domestic, volunteer, civic, and fiscal forms of support
Lecturers are …	Everybody, everywhere, backed up by wireless devices designed to provide information raw material for knowledge production
Hardware and software in schools …	Are available at low cost and are used purposively, for the selective production of knowledge
Industry views students as …	Knowledge-producing, co-workers and entrepreneurs who can support the development of focused knowledge construction

According to Lengel (2013), many education institutions have practiced the characteristics of Education 3.0 in their learning process. Most of them are higher education institution (Thomas *et al*., 2012, Rahmat & Osman, 2012 and Songkram *et al*., 2019). As we can see in Table 1.1, the teaching characteristic in Education 3.0 was more connected with technology. They use e-learning technology to produce and share knowledge. Mostly, HEIs implemented e-learning using a ready-to-use application such as Moodle LMS, Edmodo, *etc* (Light, 2012 and Al-Samarraie, 2018). Some of the HEIs also develop their own e-learning application. Those applications not only can support learning activity, but also can support evaluation activity. Assignment, assessment, scoring and marking processes are also provided by those applications. However, because those applications are separated from AIS, the examination results cannot automatically show in AIS (Badu *et al.*, 2012). The lecturer must key in it manually into AIS because most of the HEIs just developed AIS for the academic administrative purpose (Utomo & Wellem, 2013).

From a short discussion with some lecturers from institutions that used e-learning, they shared some problems when used e-learning and AIS in the separate application. They also used social media and instant messaging application to enrich

their learning process. Because of those, they must spare more time to calculate the final results because they must combine and recap from electronic and paper based marks. When all marks are recapped, then they must input the final results to the AIS. They also often late to submit the final results when they handle more subjects or classes. The on-time accomplishment of the final results is one of the performance indicators in higher education institution (BAN-PT, 2010). If many lecturers late to submit the final results, it will be affected to the institution's accreditation.

Besides with the lecturers, the discussions also are done with some students. These students used various e-learning. They used Edmodo, Moodle or their own institution's e-learning. Moodle, Edmodo and others e-learning application have been used by many HEIs (Light, 2012). The HEIs used the application because of it simple to install and supported mobile platform. For Edmodo and Moodle users, they very helped with the mobile platform services. They can access the e-learning from their mobile device anywhere and very enjoyed with the push notification function. But when they accessed the AIS with mobile device, they felt lack of function on it. They lost some information and function because the AIS did not support mobile platform yet. This also happens to the users that used their own institution's e-learning without mobile platform support. Furthermore, Lee *et al.* (2014) found accessibility problems when the application did not support mobile platform. Besides that, the mobile platform provides an ideal avenue for the transfer of knowledge which will improve the students' absorptive capacity when collaboration is used in the learning process (Ho & Chua, 2014).

The accessibility also can help parents of students to involve in their children learning process. Most of adults already have smartphone or tablet PC as their mobile device (Smith, 2013), they can use those devices to monitor their children's activity. Considering most of the time that students spent in HEIs with their lecturers (Drigas *et al.*, 2014), parents at home or at work can involve to the learning activity through mobile device. From discussion with some parents, they are not only curious for the final results in every end of semester, they also curious to what their children do and learn to achieve the results. In the other's hand, they did not know how to do that and where to access. If they get the access, they can more involve to their children education and also give values to their social live.

Besides parents, there is another stakeholder involves in Education 3.0 characteristics. The characteristic is industry involvement. Mostly, industry and HEIs

already collaborated in strategic level such as research, knowledge transfers and curriculum development (Muscio, 2013). But in operational level such as recruitment, the collaboration happens after students graduated. The industry gets information about students' achievement after they graduated (Agrawal, Rao & Venkatesh, 2016). Ideally, industry also can involve in their learning process. Industry can access students' portfolio and achievement during semester. With those, industry can select prospective candidates early before they graduated. But somehow, industry also did not have access to do that.

The number of organizations with a dedicated campus recruitment strategy has increased by a whopping 25% since 2013. They choose it because of the cost effectiveness. With the evolution of human resource (HR) into a strategic partner in the growth and performance of an organization, the challenges faced by the HR workforce have also changed. Engaging and retaining top talent are one of the biggest challenges (Kaushik, 2016). No matter how fast people run, they can significantly improve the ability to cover long distances in relatively shorter time when they use a vehicle. The same goes for hiring. Technology can help to scale the efforts, make it significantly faster and eliminate human biases. The insight an experienced interviewer can bring to the table can become even more powerful with the right tools (Bhaduri, 2016).

Based on the facts above, for the HEIs that have implemented Education 3.0 characteristics in their learning process are suggested to support those characteristics with their ICT capability. Especially for HEIs that already used e-learning or mobile learning or blended learning and also for those who already implemented student centered learning, the supporting becomes priority to overcome the current and future problems.

1.2   Problem statements

Everyone is a learner and learning can be anywhere and anytime being some of the characteristics of Education 3.0 (Moravec, 2008). Those can be facilitated by implementing e-learning/mobile learning/blended learning. A study by Badu *et al.* (2012) has found that the implementation of e-learning and AIS in separated application causing administrative problems. A preliminary study also found that lecturers must spare more time to calculate the final results because they must

combine and recap from electronic and paper based marks. This can make the submission of the final results late and affected to institutions performance.

Furthermore, Lee *et al.* (2014) found accessibility problems when the application did not support mobile platform. For Edmodo and Moodle users, they very helped with the mobile platform services. They can access the e-learning from their mobile device anywhere and very enjoyed with the push notification function. But when they accessed the AIS with mobile device, they felt lack of function on it. They lost some information and function because the AIS did not support mobile platform yet.

The Education 3.0 characteristics also talk about parent and industry involvement in education (Moravec, 2008 and Harkins, 2008). A preliminary study found parents are not only curious for the final results in every end of semester, they also curious to what their children do and learn to achieve the results. In the other's hand, they did not know how to do that and where to access. Same as with industry, when they conducted campus recruitment, they got information about students' achievement only after they graduated (Agrawal *et al.*, 2016). They hope can access students' portfolio and achievement during semester. With those, industry can select prospective candidates early before they graduated.

The HEIs who want to implement or have implemented Education 3.0 must transform their existing AIS. The transformation process must be done in a good way to provide all needs above. The good way to do the transformation is by following certain guidance (Becker, Knackstedt & Pöppelbuß, 2009).

1.3   Research questions

Considering the all facts above, we can state a few research questions (RQ) below.

RQ1: How the characteristics of Education 3.0 related to the AIS?

RQ2: How the AIS support the characteristics of Education 3.0?

RQ3: How to transform existing AIS to support Education 3.0 characteristics?

1.4   Research objectives

The research objectives were provided to answer the research questions. The objectives were the action of the research. The research objectives (RO) explained below.

RO1: To identify which characteristics of Education 3.0 are related to AIS.

RO2: To identify the kind of support from AIS to the specific characteristics of Education 3.0.

RO3: To develop a model as a transformation guide for existing AIS to support the characteristics of Education 3.0.

1.5   Scope of the research

This research only focus on the characteristics of Education 3.0 that can be supported by AIS. This research used a private higher education institution that has been using AIS and implementing the characteristics of Education 3.0 as a research object. The research object must open access to the AIS documentation and granted the data collection. The contribution of the research only focus on new wave of AIS, not the education concept. The research developed a model as a transformation guide and can be adapted in any HEIs.

1.6   Research significance

The purpose of this study is to identify the linkage between AIS and Education 3.0. The results hopefully fill the gaps when Education 3.0 implemented in the HEI. The results also can be used as the basis to identify the support from the AIS to Education 3.0. The identification becomes important because the implementation of Education 3.0 faced some problems. The enhancement of the AIS hopefully can be the solution. The enhancement may involve the integration among multi-platform. Unfortunately, in information system management, the platform issue only mentioned in the initial development. Therefore, this study also discusses the platform issue in the future development of an IS.

After the results identified, this study also identifies the guide for the transformation process. Unfortunately, none guidance found to assist the AIS

transformation to support Education 3.0. Researches by Thomas *et al*. (2012), Rahmat & Osman (2012), and Songkram *et al*. (2019) only proposed the statement of the solution, not including the guidance. Therefore, this study develops a transformation model as a contribution to the IS management concept. The developed model hopefully can guide the transformation process and enrich the IS management concept in the future.

1.7   Conceptual framework

To achieve the research objectives, some theories and concept are needed to ensure the research outcome based on proffer knowledge. The Figure 1.1 shows the used of the theories and concept in this research.

Figure 1.1: Conceptual framework

REFERENCES

Agrawal, A. K., & Mittal, G. K. (2018). The role of ICT in higher education for the 21st century: ICT as a change agent for education. *Multidisciplinary Higher Education, Research, Dynamics & Concepts: Opportunities & Challenges For Sustainable Development (ISBN 978-93-87662-12-4)*, *1*(1), 76-83.

Agrawal, N. M., Rao, M. R., & Venkatesh, S. (2016). Labour Market and Recruitment: Education and Employability–Learning from the Indian IT/ITES Industry. *India: Preparation for the World of Work*, 311-329.

Al-Qahtani, A. A., & Higgins, S. E. (2013). Effects of traditional, blended and e-learning on students' achievement in higher education. *Journal of Computer Assisted Learning*, 29(3), 220-234.

Al-Samarraie, H., Teng, B. K., Alzahrani, A. I., & Alalwan, N. (2018). E-learning continuance satisfaction in higher education: a unified perspective from instructors and students. *Studies in higher education*, *43*(11), 2003-2019.

Alyoubi, B. A., & Arif, M. J. (2014). A Comparative Study between the Academic Information System of King Abdulaziz University and other Saudi Arabia Universities. *Life Science Journal, 11(7).* 261-275.

Aparicio, M., Bacao, F., & Oliveira, T. (2016). An e-Learning Theoretical Framework. *Journal of Educational Technology & Society, 19*(1), 292-307. Retrieved from http://www.jstor.org/stable/jeductechsoci.19.1.292

Archibong, I. A., & Effiom, D. O. (2009). ICT in university education: usage and challenges among academic staff. *African Research Review*, *3*(2). 404-414

Badu, S. Q., Laisa, Z., Dungga, A., Kamuli, S., & Nurdin, M. I. (2012). Elearning Administrative Simplification Through Integration with Academic Information System of Higher Education. In *Proceeding International Symposium on Open, Distance and Elearning (ISODEL) 2012*. Cente for ICT Education, Ministry of Education and Culture.

Baker, S. E., Edwards, R., & Doidge, M. (2012). *How many qualitative interviews is enough? Expert voices and early career reflections on sampling and cases in qualitative research*. National Centre for Research Methods, Southampton.

BAN-PT. (2010). *Akreditasi Program Studi Sarjana*. Jakarta: Buku VI

Barrett, D. E., Casey, J. E., Visser, R. D., & Headley, K. N. (2012). *How do teachers make judgments about ethical and unethical behaviors? Toward the development of a code of conduct for teachers*. Teaching and Teacher Education, 28(6), 890-898.

Becker, J., Knackstedt, R., & Pöppelbuß, J. (2009). Developing maturity models for IT management. *Business & Information Systems Engineering*, *1*(3), 213-222.

Bhaduri, A. (2016, February). Technology in Recruitment. TJ Insite. Retrieved from http://www.content.timesjobs.com/

Bhattacherjee, A. (2012). *Social science research: principles, methods, and practices.* USF Tampa Library Open Access Collections.

Bøe, T., Gulbrandsen, B., & Sørebø, Ø. (2015). How to stimulate the continued use of ICT in higher education: Integrating information systems continuance theory and agency theory. *Computers in Human Behavior*, *50*, 375-384.

Borg, N., O'Hara, J., & Hutter, C. (2008). *About Edmodo*. Retrieved on March 20, 2016, from https://www.edmodo.com/images/rttd/Edmodo_RTTD_ Overview.pdf

Caceres, P., Marcos, E., & Vela, B. (2003, October). A MDA-based approach for web information system development. In *Workshop in software model engineering*.

Cai, H. C., Pan, M., Wang, Y. Z., Qu, H. G., & Chen, X. H. (2014). Information System for Geological Archive in Anshan Based on SOA. *Applied Mechanics and Materials*, *687*, 2124-2127.

Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. In *Oncology nursing forum* 41(5), 545-547.

Castronova, A. M., Goodall, J. L., & Ercan, M. B. (2013). Integrated modeling within a hydrologic information system: an OpenMI based approach. *Environmental Modelling & Software*, *39*, 263-273.

Chandler, P. D., & Redman, C. (2013). Teaching teachers for the future: Modelling and exploring immersive personal learning networks. *Australian Educational Computing*, *27*(3), 54-62.

Dervarics, C., & O'Brien, E. (2011). *Back to school: How parent involvement affects student achievement.* Retrieved on July 30, 2016, from http://www.centerforpubliceducation.org/Main-Menu/Public-education/Parent-Involvement/Parent-Involvement.html

Disanda, Y. R. (2014). Analysis The Quality of Website Service Information System Academic Integrated (SIATER) Bandar Lampung University Using Pieces Methods. In *International Conference on Engineering and Technology Development (ICETD)*.

Drigas, A., Ioannidou, R. E., Kokkalia, G., & Lytras, M. D. (2014). ICTs, Mobile Learning and Social Media to Enhance Learning for Attention Difficulties. *J. UCS*, *20*(10), 1499-1510.

Engin, M., & Atkinson, F. (2015). Faculty Learning Communities: A Model for Supporting Curriculum Changes in Higher Education. *Executive Editors*, *27*(2), 164-174.

Fortunato, D., & Bernardino, J. (2018, June). Progressive web apps: An alternative to the native mobile Apps. In *2018 13th Iberian Conference on Information Systems and Technologies (CISTI)* (pp. 1-6). IEEE.

Gerón-Piñón, G., Solana-González, P., Pérez-González, D., & Trigueros-Preciado, S. (2019). Information System Projects for Higher Education Management: Challenges for Latin American Universities. *Higher Education and the Evolution of Management, Applied Sciences, and Engineering Curricula*, 120-150.

Gerstein, J. (2014). Moving from education 1.0 through education 2.0 towards education 3.0. *Educational Technology Faculty Publications and Presentations*. Department of Educational Technology. BSU.

Giaglis, G. M. (2001). A taxonomy of business process modeling and information systems modeling techniques. *International Journal of Flexible Manufacturing Systems*, 13(2), 209-228.

Goni, F. A., Chofreh, A. G., Mukhtar, M., Sahran, S., Shukor, S. A., & Klemeš, J. J. (2017). Strategic alignment between sustainability and information systems: A case analysis in Malaysian public Higher Education Institutions. *Journal of Cleaner Production*, *168*, 263-270.

Gornall, L., Cook, C., Daunton, L., Salisbury, J., & Thomas, B. (Eds.). (2013). *Academic Working Lives: Experience, Practice and Change*. A&C Black.

Gutierrez, F. M. (2006) Faculty best practices using blended learning in e-learning and face-to-face instruction. *International Journal on E-Learning*, 5, 313–337.

Harkins, A. M. (2008). Leapfrog Principles and Practices: Core Components of Education 3.0 and 4.0. *Futures Research Quarterly*, *24*(1), 19-31.

Hedman, J., & Sarker, S. (2015). Information system integration in mergers and acquisitions: research ahead. *European Journal of Information Systems*, *24*(2), 117-120.

Heick, T. (2015). 8 Characteristics of Education 3.0 -. Retrieved from https://www.teachthought.com/pedagogy/8-characteristics-of-education30/

Ho, R. C., & Chua, H. K. (2015). The Influence of Mobile Learning on Learner's Absorptive Capacity: A Case of Bring-Your-Own-Device (BYOD) Learning Environment. In *Taylor's 7th Teaching and Learning Conference 2014 Proceedings* (pp. 471-479). Springer Singapore.

Hockly, N. (2013). Digital technologies in low-resource ELT contexts technology for the language teacher. *ELT journal*, cct063.

Indrayani, E. (2013). Management of Academic Information System (AIS) at Higher Education in The City of Bandung. *Procedia-Social and Behavioral Sciences*, *103*, 628-636.

Jones, C. (2015). Theories of Learning in a Digital Age. *Networked Learning, Research in Networked Learning*. Springer International Publishing Switzerland.

Jude, L. T., Kajura, M. A., & Birevu, M. P. (2014). Adoption of the SAMR Model to Asses ICT Pedagogical Adoption: A Case of Makerere University. *International Journal of e-Education, e-Business, e-Management and e-Learning*, *4*(2), 106.

Kaushik, A. (2016, June). Campus Recruitment 2016. TJ Insite. Retrieved from http://www.content.timesjobs.com/

Kautsarina, H., Arief, A., & Sensuse, D. I. (2018). Towards Development of Academic Information System–as-a-Services. In *2018 International Conference on ICT for Rural Development (IC-ICTRuDev)* (pp. 85-91). IEEE.

Keats, D., & Schmidt, J. P. (2007). The genesis and emergence of Education 3.0 in higher education and its potential for Africa. *First Monday*, *12*(3).

Khan, B. (2005) *Managing e-learning strategies: Design, delivery, implementation and evaluation*. Hershey, PA: Idea Group Inc.

Krishnaveni, R., & Meenakumari, J. (2010). Usage of ICT for Information Administration in Higher Education Institutions - A study. *International Journal of Environmental Science and Development*, *1*(3), 282.

Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. Sage.

Landoll, D. J. (2017). *Information Security Policies, Procedures, and Standards: A Practitioner's Reference*. CRC Press.

Laudon, K. C., & Laudon, J. P. (2016). *Essentials of Management Information Systems. 12th Edition*. New York. Pearson.

Lee, G. H., Talib, A. Z., Zainon, W. M. N. W., & Lim, C. K. (2014). Learning history using role-playing game (RPG) on mobile platform. *Advances in Computer Science and its Applications*, 729-734.

Leh, M., Bajwa, S., & Chaubey, I. (2013). Impact of land use change on erosion risk: an integrated remote sensing, geographic information system and modeling methodology. *Land Degradation & Development*, *24*(5), 409-421.

Lengel, J. G. (2013). *Education 3.0: Seven steps to better schools*. New York: Teachers College Press.

Li, G., Muthusamy, V., & Jacobsen, H. A. (2010). A distributed service-oriented architecture for business process execution. *ACM Transactions on the Web (TWEB)*, *4*(1), 2.

Light, D. (2012). Principals for Web 2.0 Success: 10 Ways to Build Vibrant Learning Communities with the Read/Write Web. *Learning & Leading with Technology*, *39*(8), 18-20.

Lubis, A. H., Idrus, S. Z. S., & Sarji, A. (2018). ICT Usage Amongst Lecturers and Its Impact Towards Learning Process Quality. *Jurnal Komunikasi: Malaysian Journal of Communication*, *34*(1).

Marshall, B., Cardon, P., Poddar, A., & Fontenot, R. (2013). Does sample size matter in qualitative research? A review of qualitative interviews in IS research. *Journal of Computer Information Systems*, 54(1), 11-22.

Mayadas, A. F. & Picciano, A. G. (2007) Blended learning and localness: The means and the end. *Journal of Asynchronous Learning Networks*, 11, 3–7.

Meirelles, P., Aguiar, C. S., Assis, F., Siqueira, R., & Goldman, A. (2019, July). A Students' Perspective of Native and Cross-Platform Approaches for Mobile Application Development. In *International Conference on Computational Science and Its Applications* (pp. 586-601). Springer, Cham.

Meyen, E., Aust, R., Gauch, J. M., Hinton, H. S., Isaacson, R. E., Smith, S. J. & Tee, M. J. (2002), E-learning: Aprogrammatic research construct for the future. *Journal of Special Education Technology*, 17, 37–46.

Mokhtar, S. A., Anuar, S. M. S., & Puteh, S. (2014, August). Information system model for the measurement of learning outcome attainment. In *Engineering Technology and Technopreneuship (ICE2T), 2014 4th International Conference on* (pp. 37-40). IEEE.

Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-Learning, online learning, and distance learning environments: Are they the same? *The Internet and Higher Education*, 14(2), 129-135.

Moravec, J. (2008) *Moving beyond Education 2.0*. Education Futures. Retrieved on August 25, 2016 https://educationfutures.com/blog/2008/02/moving-beyond-education-20/

Muscio, A. (2013). University-industry linkages: What are the determinants of distance in collaborations?. *Papers in Regional Science*, *92*(4), 715-739.

Norman, D. A. (2014). Some observations on mental models. In *Mental models* (pp. 15-22). Psychology Press.

Novak, J. D. (2011). A Theory of Education: Meaningful Learning Underlies the Constructive Integration of Thinking, Feeling, and Acting Leading to Empowerment for Commitment and Responsibility. *Aprendizagem Significativa em Revista/Meaningful Learning Review*. V1(2). pp 1-14.

Nuraeni, A. (2012). *Analisis Tata Kelola Teknologi Informasi Menggunakan Framework COBIT 5 pada Domain DSS (Studi Kasus di Universitas Langlangbuana Bandung)*. Universitas Langlangbuana: Master's Thesis

Obasi, N., Nwachukwu, E. O., & Ugwu, C. (2013). A Novel Web-Based Student Academic Records Information System. *West African Journal of Industrial and Academic Research*, 7(1), 31-47.

OMG. (2001). MDA. Retrieved from https://www.omg.org/mda/

OpenGroup. (2005). Service-Oriented Architecture – What Is SOA? Retrieved from https://www.opengroup.org/soa/source-book/soa/p1.htm

Oye, N. D., Noorminshah, A. I., & Rahim, N. Z. A. (2012). Acceptance and usage of ICT by university academicians using UTAUT model: a case study of University of Port Harcourt, Nigeria. *Journal of Emerging Trends in Computing and Information Sciences*. 3(1). 81-89.

Petre, M. (2013, May). UML in practice. In *2013 35th International Conference on Software Engineering (ICSE)* (pp. 722-731). IEEE.

Poole, J. D. (2001). Model-driven architecture: Vision, standards and emerging technologies. In *Workshop on Metamodeling and Adaptive Object Models, ECOOP* (Vol. 50).

Pratiwi, D. (2013). Implementation of Function Point Analysis in Measuring the Volume Estimation of Software System in Object Oriented and Structural Model of Academic System. *International Journal of Computer Applications*, *70*(10), 1-4.

Pressman, R. S. (2015). "*Software Engineering A Practitioner's Approach*", Mc Graw-Hill International Edition, 2010.

Puentedura, R. (2010). *SAMR and TPCK: Intro to advanced practice.* Retrieved on March 25, 2016, from http://hippasus.com/resources/sweden2010/ SAMR_TPCK_IntroToAdvancedPractice.pdf

Rahmat, R. A. A. O., & Osman, K. (2012). From Traditional to Self-Regulated Learners: UKM Journey Towards Education 3.0. *Procedia-Social and Behavioral Sciences*, *59*, 2-8.

Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (Eds.). (2013). *Qualitative research practice: A guide for social science students and researchers*. SAGE.

Robinson, S., Arbez, G., Birta, L. G., Tolk, A., & Wagner, G. (2015). Conceptual modeling: definition, purpose and benefits. In *2015 Winter Simulation Conference (WSC)* (pp. 2812-2826). IEEE.

Romrell, D., Kidder, L. C., & Wood, E. (2014). The SAMR Model as a Framework for Evaluating mLearning. *Journal of Asynchronous Learning Networks*, *18*(2), n2.

Rose, S., Spinks, N., & Canhoto, A. I. (2014). *Management research: applying the principles*. Routledge.

Sari, W. P. (2012). *Perancangan Arsitektur Enterprise Sistem Informasi Akademik Universitas Langlangbuana (SIAk UNLA) Menggunakan TOGAF*. Universitas Langlangbuana: Master's Thesis.

Sarkar, S. (2012). The role of information and communication technology (ICT) in higher education for the 21st century. *Science*, 1(1), 30-41.

Seaman, C. B. (2009). Qualitative methods in empirical studies of software engineering. *IEEE Transactions on Software Engineering*, *25*(4), 557-572.

Sharma, R., & Sood, M. (2011, August). Cloud saas and model driven architecture. In *International Conference on Advanced Computing and Communication Technologies (ACCT11)* (pp. 978-981).

Singh, Y., & Sood, M. (2010). The impact of the computational independent model for enterprise information system development. *International Journal of Computer Applications*, *11*(8), 24-28.

Smith, A. (2013). Smartphone ownership—2013 update. *Pew Research Center: Washington DC*, *12*, 2013.

Soares, R. P., Sediyono, E., & Pakereng, I. (2013). The analysis of academic information system design of IPDC Dili-Timor Leste by using EAP approach. *International Journal of Computer Applications*, *84*(15).

Solar, M., Sabattin, J., & Parada, V. (2013). A Maturity Model for Assessing the Use of ICT in School Education. *Educational Technology & Society*, *16*(1), 206-218.

Sommerville, I. (2013). Software engineering. 6th. *Ed., Harlow, UK.: Addison-Wesley*.

Songkram, N., Chootongchai, S., Khlaisang, J., & Koraneekij, P. (2019). Education 3.0 system to enhance twenty-first century skills for higher education learners in Thailand. *Interactive Learning Environments*, 1-17.

Sousa, R., Oliveira, A., & Ramos, P. (2016). Information system to manage the evaluation of performance of education professionals in a pre-school? A model in development. *In Information Systems and Technologies (CISTI), 2016 11th Iberian Conferen*ce on (pp. 1-6). AISTI.

Stevenson, M., Cevenini, P., Temple, I., Halkett, R., & Patton, R. (2011). *Transforming Education, Transforming Lives: A Path Toward Next Generation Learning. The Cisco Connected Insight Series*. Retrieved on March 20, 2016, from https://www.cisco.com/web/learning/le21/le34/downloads/689/educause/ whitepaper.pdf

Su, B., Wu, H., Zheng, X., Zhang, K., & Jiang, Q. (2015, December). Army Tactical Information System Software Framework Based on SOA Design. In *2015 International Conference on Intelligent Transportation, Big Data and Smart City* (pp. 137-139). IEEE.

Thomas, A. M., Shah, H., Moore, P., Rayson, P., Wilcox, A. J., Osman, K., ... & Pham, H. V. (2012). E-Education 3.0: Challenges and Opportunities for the Future of iCampuses. *In Complex, Intelligent and Software Intensive Systems (CISIS), 2012 Sixth International Conference* on (pp. 953-958). IEEE.

Toro, U., & Joshi, M. (2012). ICT in Higher Education: Review of Literature from the Period 2004-2011. *International Journal of Innovation, Management and Technology*, 3(1), 20.

Triperina, E., Sgouropoulou, C., & Tsolakidis, A. (2013). Academis: an ontology for representing academic activity and collaborations within HEIs. *In Proceedings of the 17th Panhellenic Conference on Informatics* (pp. 264-271). ACM.

Tsadimas, A., Kapos, G. D., Dalakas, V., Nikolaidou, M., & Anagnostopoulos, D. (2014, June). Integrating simulation capabilities into SysML for enterprise information system design. In *2014 9th International Conference on System of Systems Engineering (SOSE)* (pp. 272-277). IEEE.

Turban, E., Volonino, L., & Wood, G. (2013). *Information Technology for Management: Advancing Sustainable, Profitable Business Growth*. NJ. John Wiley & Sons, Inc.

Twyman, J. S. (2015). Envisioning education 3.0:: The fusion of behavior analysis, learning science and technology. *Revista mexicana de análisis de la conducta= Mexican journal of behavior analysis*, 40(2), 20-38.

Ujunju, M. O. (2012). Evaluating the role of information and communication technology (ICT) support towards processes of management in institutions of higher learning. *Editorial Preface*, *3*(7).

Utami, E., & Raharjo, S. (2014). Database Security Model in the Academic Information System. *International Journal of Security and Its Applications*, *8*(3), 163-174.

Utomo, W. H., & Wellem, T. (2013). Modeling of Business Process Management of Academic Affair Information System. *International Journal of Computer Applications*, *64*(16).

Venkatesh, V., Croteau, A. M., & Rabah, J. (2014, January). Perceptions of effectiveness of instructional uses of technology in higher education in an era of Web 2.0. *In 2014 47th Hawaii International Conference on System Sciences* (pp. 110-119). IEEE.

Walsh, C. (2015). *What does the future hold for learning technologies in higher education?* Retrieved on April 5, 2016, from http://lcp.org.uk/index.php/2015/02/what-does-the-future-hold-for-learning-technologies-in-higher-education/

Widodo, H. P., Kertahadi, M., & Suyadi, I. (2015). The Influence of Job Relevant Information, Task Technology Fit, and Ease of Use Information Technology Due to the User Performance: A Case Study on the End Use of Academic and Financial Information System in University of Brawijaya. *Asian Journal of Social Sciences & Humanities*, *4*(2), 128-138.

Wilson, S. M. & Piterson, P. L. (2006). *Theories of Learning and Teaching: What Do They Mean for Educators?*. Washington. NEA.

Wilson, V. (2016). Research Methods: Triangulation. *Evidence Based Library and Information Practice*, *11*(1 (S)), 66-68.

Yan, Y., Yao, Z., & Sijia, L. (2015, November). A Dispatch Method of Complex Information System Based on Service-Oriented Architecture. In *2015 Eighth International Conference on Internet Computing for Science and Engineering (ICICSE)* (pp. 35-38). IEEE.

Yin, R. K. (2015). *Qualitative research from start to finish*. Guilford Publications.

Yin, R. K. (2017). *Case study research: Design and methods*. Sage publications.

Yuhana, U. L., Raharjo, A. B., & Rochimah, S. (2014). Academic information system quality measurement using quality instrument: A proposed model. *In 2014 International Conference on Data and Software Engineering (ICODSE)* (pp. 1–6). http://doi.org/10.1109/ICODSE.2014.7062684

Zhou, H., & Wang, J. (2016). Integration and implementation of logistics information system based on SOA technology. *Management & Engineering*, (22), 100.

Zhu, J., Wright, G., Wang, J., & Wang, X. (2018). A critical review of the integration of geographic information system and building information modelling at the data level. *ISPRS International Journal of Geo-Information*, 7(2), 66.