E-learning process maturity level: a conceptual framework

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Abstract. ICT advancement is a sure thing with the impact influencing many domains, including learning in both formal and informal situations. It leads to a new mindset that we should not only utilize the given ICT to support the learning process, but also improve it gradually involving a lot of factors. These phenomenon is called e-learning process evolution. Accordingly, this study attempts to explore maturity level concept to provide the improvement direction gradually and progression monitoring for the individual e-learning process. Extensive literature review, observation, and forming constructs are conducted to develop a conceptual framework for e-learning process maturity level. The conceptual framework consists of learner, e-learning process, continuous improvement, evolution of e-learning process, technology, and learning objectives. Whilst, evolution of e-learning process depicted as current versus expected conditions of e-learning process maturity level. The study concludes that from the e-learning process maturity level conceptual framework, it may guide the evolution roadmap for e-learning process, accelerate the evolution, and decrease the negative impact of ICT. The conceptual framework will be verified and tested in the future study.

1. Introduction

The rapid advancement of information and communication technology (ICT) from time to time is a sure thing. Indonesia has internet penetration number 50.4% [1] covering all population in 2016. However, the utilization for education domain is still low, only 7.8% for college students, and 6.3% for students % [1]. According to the ICT Development Index, a composite index measuring ICT usage to enhance country’s growth a development, Indonesia ranks 115th from 175 countries in 2016 [2]. These phenomena may lead Indonesian citizen gain more negative rather than positive impacts from the technology advancement. Aside from the advantages of accessibility towards data, information, and knowledge on one hand, people are also perplexed by the information overload, explosion, hoax, misuse [3], cyber threats, and cyber crime [4].

ICT has the power to inspire us to transform the way we live, the way we teach, and the way we learn [5]. Learners become digital learners because of the ubiquity of technology that surrounds them [5]. In a broad sense, the way people use an electronic device (usually a computer) with learning technology is described as e-learning to develop new knowledge and skills individually or collaboratively [6]. Along with ICT advancement, e-learning implementation has evolved bringing us web-based learning, mobile learning, and the latest, ubiquitous learning. Those learning technologies increase the ease of the learning process regarding the recorded process, material accessibility, immediacy of access, interactivity, and integration of learning with daily activities [7]–[9]. However, this trend use technology dependency as the approach to define an e-learning state [8][6][7]. Those technologies are used to support mobility and ubiquitousness are expensive, hard to find on a regular basis, and not affordable for a particular type of learners. It relates to digital divide issues [5] where
utilization level of e-learning is different regarding knowledge ability, comprehension of ICT literacy backgrounds, and ICT accessibility. How e-learning technologies can be effective to all types of learners regarding its advancement? A concept used to answer this problem is e-learning process evolution. It requires the learner to improve not only knowledge ability for a particular topic but also the learning process itself. This research uses context of e-learning process as the process of conducting learning supported by ICT, as used in [10].

By nature, people adopt ICT gradually, influenced by many factors. However in another side, there are government policies related to e-learning which apply globally and enforce simultaneously in all schools and universities in Indonesia. Enforcing a policy without a preliminary analysis of learner conditions may results in the ineffectiveness and inefficiency. The ineffectiveness and inefficiency bring a risk of country financial losses. Accordingly, there is a need for evolutionary path like a multi-level transformation from an initial to a target level that shows progression, called maturity model [11]. The target is to achieve maturity, the state of being complete, perfect, or ready [12]. This study explores related works about e-learning process evolution from the individual point of view using maturity level concept. Ideal conditions expected is achieving the learning objective using accessible ICT advancement to conduct the e-learning process in both formal and informal situations. Furthermore, this approach attempts to reduce potential losses regarding the government program in ICT utilization for education because of the improper use of the ICT. The following sections explain the study as follows: Section 2 discusses about related works to define the e-learning process influencing factors and e-learning maturity level. Section 3 discusses the resulting conceptual framework. The last section describes the conclusion of this study.

2. Related Works

This section discusses factors affecting the maturity level progression of e-learning process through the extensive literature review by comparing the similar ideas, contrasting the differences, and synthesizing the relevant ideas from these related works. It makes sense to use a maturity model when there are requirements for a structured approach, a measurable result based on the established body of knowledge, a defined roadmap, and ability to monitor and measure progress particularly in the presence of change [13]. Different domains have utilized a maturity model concept, so it may also be applied in ICT based learning development domain.

There are previous research using capability approach to explain the maturity level of learning, e-learning maturity model (eMM) with e-learning process capability over an achieved objective [14] and CMM in e-learning [15]. The level consists of delivery, planning, definition, management, and optimization. The process areas consist of learning, development, support, evaluation, and organization. Another capability related work is learning maturity model [16], which uses Bloom’s Taxonomy Revised by Marzano [17] to define maturity levels as knowledge ability development assessment. The levels consist of motivation and knowledge retrieval development, synthesis development, analysis development, usage, and learning. The factors affecting the learning process are motivation, objective, and knowledge ability [16]. Learning objective is a baseline for knowledge ability development progression. Knowledge ability, based on Marzano’s new taxonomy, consists of retrieve, synthesis, analysis, and application [17]. Learning performance is monitored through learning result tracking. These maturity models do not represent a progression roadmap, but to what extent the process in e-learning is adequate.

A discussion of technology trend to support e-learning determines progression maturity levels suitable with this study context, in which commonly uses three stages: e-learning, mobile learning (m-learning), and ubiquitous learning (u-learning), as stated in [9], [6] and [18]. Related works in ICT-based learning determine u-learning as the highest trend in e-learning. Ogata defines u-learning characteristics as follows: permanency, accessibility, immediacy, interactivity, and situatedness [7][19]. Meanwhile, Hwang defines u-learning environment characteristics as context-aware environment that provides personalized support in the right way, time, and place, enables seamless
learning, and adapts with the various mobile devices [8]. Both studies conducted by Ogata and Yano [7] along with Hwang [8] emphasize that u-learning is about the context-aware environment to support learning. Another point of view delivered by Cope and Kalantzis, who stated that u-learning exploits ubiquitous computing as a product of social needs bringing social effects such as situated, interactive, participatory, spatial, temporal, cognitive, and intuitive computing [5].

Besides defining u-learning characteristics as a single object, there are also works characterizing u-learning as a learning trend along with e-learning and m-learning. In the following research, Hwang and Liu explain u-learning as paradigm shifts in e-learning [6] requiring a particular type of ICT advancement. Yahya, et al. [9] describe these trends by adopting characteristics from Ogata and [7], Chen et al. [20], Curtis et al. [21], Hwang et al. [22], and Chiu et al. [23]. In another research, Ogata and Uosaki explain this trend using ICT advancement time chart in research on computers in education [19] covering three kinds of learners: personal, group, and social learners. Each improvement enables a particular learner to learn with specific ICT advancement like fixed/PC, multimedia like game-based learning, internet allowing the emergence of web-based learning/e-learning and computer-supported collaborative learning, and last, mobile and surround technology supporting m-learning and u-learning. In further technology-driven research, Ogata and Uosaki [19] offer seamless learning, which is the situations where students can learn whenever they want in a variety of scenarios. These progressions of e-learning discussed above are affected by certain factors.

Sfenrianto, et.al. discuss e-learning process factors for learning material personalization consisting of learning styles, motivation, and knowledge ability [10]. According to Hwang, the motivation includes learning needs, a learning style with preferences, and also considers schedules [24]. Meanwhile, Alkis et al. group factors related with e-learning acceptance into dimensions consisting of social environment, acceptance of e-learning application, individual technical and non-technical skills, desired system features to support e-learning, institutional factors defining learning motivation, and e-learning popularity [25]. Bonaui et.al determine three factors used to describe the level of ubiquity in a learning environment which are the type of learning, learning methodologies, and technological mediation [26].

3. E-Learning Process Maturity Level Conceptual Framework
In design science, an approach to propose solution is by forming construct as research artefacts [27]. Schon in [27] states that constructs can provide the language in which problems and solutions are defined and communicated. Constructs are used to understand components for the to-be-built conceptual framework. The proposed conceptual framework adopting those constructs is illustrated in Figure 1 with elements consist of: learner, learning objectives, e-learning process, continuous improvement, evolution path, and factors influencing the maturity grouped as learner-related factors and technology-related factors.
Figure 1. E-Learning Process Maturity Level Conceptual Framework

Learner is someone, a group, or a community who conduct the e-learning process. In conducting the process, learner has certain learning objective. Level of knowledge in Bloom Taxonomy revised [28] with creation as the highest goal, describes these learning objectives. The further meaning of reaching this state is that a learner can accomplish his/her job immediately after learning.

E-learning process is defined as conducting learning using ICT which can evolve to achieve continuous improvement in context of higher learning objective. E-learning process as a system with continuous improvement can be described with the I-P-O model. Input can be described as learner status (represented by motivation, knowledge ability, motivation, and learning objective). Output represents how far the e-learning process can improve the learning outcome (knowledge ability and e-learning skill) and achieve the learning objective. Through the output, the learner status and achievement can be evaluated. In addition, feedback can be formulated to improve it. This I-P-O and feedback model form a cycle of which a learner can conduct over and over following certain path of improvement, the maturity level for e-learning process.

The evolution path, as illustrated in Figure 2, describes ICT utilization progression from time to time. It uses the progression type of maturity model which has a levelling mechanism representing a transformation of the object, the e-learning process, into a more advanced state. The proposed maturity levels for the e-learning process adopts technology trend in supporting e-learning, which are web based learning, m-learning, and u-learning. As known, learning is possible conducted without ICT so that there should be a level 0. It is called ‘traditional learning’. In addition, maturity level needs a maturity goal as an ideal state. This study proposes seamless learning to answer it.

Seamless learning, ability in doing learning anytime, anywhere, curiosity/inquiry based, and it generates applicable knowledge to get a job done immediately as the learning outcome. The analogy to explain this condition is that self-directed learners know what to learn and what material is needed, know how to access and use it. The approach used in seamless learning utilizes the learning material as a standalone entity. It relates to another material according to learners’ needs to gain the capability to create something or get the job done. Meanwhile in conventional learning, they are grouped into topics and hierarchical following a curriculum.

Figure 2 describes the e-learning process evolution, explained as maturity levels in the chart of two dimensions (x, y). The x-axis represents the progression stage of maturity level. The y-axis represents particular e-learning advance's frequency of utilization. A variable represents each influencing factor. Those variables will then together contribute to achieve a maturity level. The notation of this equation can be written as follows. If each factor is represented by $a \rightarrow b \rightarrow c \rightarrow d \rightarrow e \rightarrow f$, then the achievement of a maturity level is expressed by $v \rightarrow (a, b, c, d, e, f)$. 

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**Legend:**
- Learner
- E-learning process
- Continuous Improvement
- Input
- Output
- Knowledge ability
- Learning methodology
- Learning motivation
- Technology
- ICT accessibility
- E-learning skill
Moving up from one level to another follows an established improvement roadmap. It covers the levelling mechanism, the current condition measurement, and the expected condition. A learning objective becomes determinant to what extent the learning process utilizes particular ICT. This principle allows learners to improve the e-learning process, considering the condition of each factor affecting the process.

Several factors related to learners and ICT influence the individual e-learning process evolution and measured regarding its contribution in supporting the e-learning process to move up to a higher maturity level. Learner-related factors include learning styles, knowledge ability, methodology, and motivation. On the other hand, technology-related factors include ICT accessibility and e-learning skills. Each factor has its stages to represent the state of a learner in using e-learning with a defined goal as the highest stage, illustrated as a vector $\vec{a}, \vec{b}, \vec{c}, \vec{d}, \vec{e}, \vec{f}$. The ideal is achieving seamless learning with curiosity as the driver for learning methodology, using effort as motivation, the consciousness of learning styles, also capability in choosing and using specific accessible ICT as learning tools.

Learning style is adopted as a factor affecting the e-learning process based on previous research about influential factors of the e-learning process [10] and factors in mobile learning adoption [29]. In this factor, the highest goal is not related to a certain style, but the ability of a learner identifies which one is suitable for him/her. Learning styles and e-learning skills represent the ability of a learner to choose and use the most appropriate learning tools.

As mentioned in related research that effort is a fundamental indicator of a student’s motivation [10], it becomes the highest goal of motivation to reach in learning in this research context. Another factor is learning methodology including directed learning, problem-based learning, project-based learning, and inquiry-based learning. Inquiry-based learning uses curiosity as the driver to do learning. It acts as proposed highest goal of learning methodology to be achieved to reach seamless learning.

Improving each learner’s factors is not necessarily enough. There are also factors related to ICT to gain a higher level of maturity for the e-learning process. The first factor is e-learning skills, a proposed factor to measure capability to identify and use a particular learning tool. E-learning skill is part of comprehension in ICT literacy or mentioned as e-literacy [30] or digital literacy [3], specifically applied for learning tools. This skill covers the ability to identify, choose, and use appropriate ICT to support learning, and know-how to use basic functions of this technology to support learning (upload, download, save, retrieve, and share). This skill requires alignment with accessibility towards ICT itself.

Last factor proposed in this research is accessibility to ICT advances to support learning. The ability to experience various technology types in which learners can experience web-based learning, m-
learning, u-learning, and seamless learning is a prerequisite to conduct learning. In this context, ability to access particular technology is varied. Therefore, learners need a maturity roadmap to guide which level they are at related to technology accessibility and what technology should be used to get to the next level. It can be explained more with a theory about types and levels of technology use [31].

4. Conclusion
E-learning process is a form of self-directed learning in which its gradual improvement may be conducted by aligning learners’ needs and conditions. This study proposes A Conceptual Framework of E-learning Process Maturity Level as an evolution roadmap for this improvement using maturity level concepts. The goal is achieving learning driven by curiosity, anytime, anywhere, using accessible ICT to accomplish learners’ work immediately – called seamless learning. In order to achieve it, a learner should pass these levels: traditional learning, web-based learning, m-learning, u-learning. The framework has elements consists of learner factors, e-learning process, continuous improvement, evolution path, and technology-related factors. It serves as ICT based learning evolution roadmap, a guideline to accelerate the evolution, and a way to decrease the number of ICT utilization negative impacts by optimizing the use of ICT for learning. For future study, this research will be verified and tested in the future study.

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