

# SMEMFLE I 4.0 DE:

## A synergetic multi-layered educational model for learning excellence in industry 4.0 and disruption era

Didi Suherdi

Department of English Language Education  
Universitas Pendidikan Indonesia  
Bandung, Indonesia  
suherdi\_d@upi.edu

**Abstract**—This paper is intended to explicate an education model developed as a response to the challenges posed by the advancement of science and technology in Industry 4.0 era. As has been well-documented, industry revolutions have always brought about new challenges to education. The invention of paper has hanged oral to written tradition of doing education (in Industry 1.0), followed by mass education at schools and universities (in Industry 2.0), and ICT based education (in Industry 3.0), have radically changed the ways of doing education. In Industry 4.0, new alternatives are now of high demand. In this relation, a set of principles developed out of some review of related research findings and theoretical thoughts has been formulated and will be explicated in this paper. In other words, throughout this paper, the alternative education model for learning excellence in Industry 4.0 and disruptive era, called SMEMFLE I 4.0 DE, standing for Synergetic, Multilayered, Educational Model for Learning Excellence in Industry 4.0 and Disruption Era will be presented, illustrated, and supported by related research findings. From the explication, it can be concluded that the model is not only plausible, but also enlightening.

**Keywords**—industry 4.0; digital technology; technology-cultivated teaching; self-regulated learning; transversal competence development

### I. INTRODUCTION

The fourth industrial revolution (Industry 4.0, hence I.40) and its consequent disruptive impacts of some innovative technology bring about radical changes in the way we live our life. Triggered by the advancement of digital technology, I.4.0 evolves in a very rapid speed, and in some cases, brings with its disruptive situations. As what can be summarized from many sources [1-3], disruptions are inherent and logical parts of revolutions, particularly in industry revolutions. I.1.0, for example, was triggered by the invention of steam power, in which manual production was significantly disrupted. I.2.0 was characterized by mass production setup, in which things began to be massively manufactured, and to a great extent, hand-made production was disrupted. In the meantime, I 3.0 added e-technology to the mass production, in which robots replace human labors, and, to a significant extent, human labor and electrical technology were disrupted. In similar fashion, I.4.0 potentially brings more sophisticated disruptions to our world. I

4.0 is characterized by cross-linked production supported by internet of things (IoT), cloud computing, and big data technology, while preserving automation, enhancing connection, and developing system integration. It is also I.4.0 is characterized by ‘CPS [cyber physical system] and other new technologies such as 3D-printing, block chain, and artificial intelligence’ [2].

As thus far explained and will be clear along the discussion in this article, new development, has always brought with it both positive and negative effects. Along with sophisticated capability of new technologies in helping many human works, some of them have significantly disrupted existing technologies. In today’s world, we witnessed the ‘death’, or at least the ‘torpor’, of the domination of ‘Nokia’, the use of floppy disks, film negatives, etc. Other examples include some conventional transport companies that were disrupted by online ones, the jobs of toll gate attendants by automatic vending machines, etc. Hence, it is clear that apart from its benefits, new technology brings with its negative impacts which may lead serious problems for some of us. It is also clear that disruption is neither a new phenomenon, nor avoidable in the course of science and technology development. Indeed, ‘It is exciting to live in a time of real change and transformation. It is also scary’ [3]. To sum up, industry revolutions always bring both positive and negative impacts for our life. Serious responses are imperative if successful life is targeted.

Along with this course of development, education has been developed in a similar pattern [1]. Education 1.0 (corresponding to I.1.0, and hence E.1.0) was characterized by the replacement of oral language by symbols, while E.2.0 by mass education for reading and writing, paper making and printing technology. In the meantime, in E.3.0, we witness the development of flipped classrooms, and E.4.0, we are witnessing the development of internet of things, cloud computing, and big data as well as the enhancement of artificial intelligence, virtual reality and augmented reality technology use in education. Education changes in conjunction with the changes of the factors related to its existence. Along human history, education is crucial for both individuals and nations’ success, and it always needs to be adaptive to the demands of the society. It is quite unfortunate that today’s education, however, ‘was designed to meet the need of the past

revolutions. The systems run are not suited for the automation economy’ [2]. In this perspective, it is clear that there is a gap between the existing and the expected systems of education that is demanded by I.4.0 era. In conjunction with this problem, liberal arts education and upskilling be an alternative [2]; and in this relation, liberal arts will gain more significance in the twenty-first century [4]. In addition, cognitive flexibility and the habits of mind that allows for lifelong learning will far more be needed than before.

*Cognitive flexibility and the habits of mind that allow for life-long learning* appears to be the key qualities that students need to be equipped with in any education program. In fact, as identified by WEF “Future of Jobs” report, cognitive flexibility together with emotional intelligence are two new skills listed in the top ten of skills needed by employers by 2020 [2]. The other 8 include complex problem solving, critical thinking, creativity, people management, coordinating with others, judgment and decision making, service orientation, and negotiation. Another key capacity that one has to have in order to benefit I.4.0 opportunities is digital literacy [2,5-7]). Digital literacy may serve as the catalyst that speeds up the development of other skills. Hence, knowing this kind of literacy better is also key to better understanding of this article. For the very reason, it will be discussed in the following section.

To get a clear idea of what digital literacy is in this article, a definition will be chosen and concisely discussed in this section. For this purpose, will be taken as the basis of digital literacy concept used throughout this article, in which digital literacy is defined as:

*The awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyse and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process [5].*

From the definition, it can be understood that digital literacy is a comprehensive concept which includes not only the ability of using, but also awareness and attitude towards digital tools and facilities, on the one hand; and on the other hand, it also includes not only ‘use’ the devices in a common sense manner, but rather various abilities of identifying, accessing, managing, integrating, evaluating, analyzing, and synthesizing digital resources, even constructing new knowledge, creating media expressions, and communicating with others. Hence, it is clear the reason why digital literacy ‘becomes not only a key factor in enabling participation in education, as well as employment and other aspects of social life, but also a means of gaining some understanding of the world’ [8]. At the heart of digital literacy is Information Communication Technology (ICT). While digital literacy is key to I.4.0, ICT literacy, as will be discussed later, is key to digital literacy [8].

From the explanation in the previous paragraph, it is clear that education is faced with a far more complicated and sophisticated demands and challenges of the 21<sup>st</sup> century, with

its digital technology and disruptive phenomena ([2,9-12]). Education is now in a very difficult era, and therefore, multifaceted, careful and serious considerations need to be synergistically developed to meet the demands. In fact, this need has long been identified by such authors [13,14]. In this conjunction, I propose a synergetic, multilayered model, called SMEMFLE I 4.0 DE (Synergetic Multilayered Educational Model for Learning Excellence in Industry 4.0 and Disruption Era), consisting of four key components: ICT cultivation (ICTC), Self-regulated Learning (SRL), and transversal competence development (TCD), and the core, i.e. the subject matter. A synergetic and multilayered model is imperative if optimum achievement is to be targeted, and disruption effect is to be well responded. To give readers clear ideas on SMEMFLE I 4.0 DE, explanations, illustrations, and discussions of each layer will be presented in the following sections.

## II. SMEMFLE I 4.0 DE

SMEMFLE I 4.0 DE is designed to help learners develop a set of competences that they needed to serve as excellent whole persons in the 21<sup>st</sup> century context. To be specific, it is designed to develop persons with maximum contribution to human life in this era and maximum resilience in dealing with disruptions brought with by the rapid advancement of science and technology inherent in this changing era. To achieve this seemingly too enthusiastic goal, the model has been designed to develop a comprehensive set of qualities highly required for a successful life in today’s context, and hence, TCD becomes the first and most fundamental layer in this model. This layer is believed to be able to provide ‘students with the basic knowledge, abilities and qualities required to translate competences into suitable behavior for organizational purposes’ and serves as the basis for ‘personal realization and development for active citizenship, social inclusion, and employment [15]. UNESCO identifies six groups of skills and qualities included in the definition of transversal competencies, i.e. critical and innovative thinking, interpersonal skills, intrapersonal skills, global citizenship, media and information literacy, and others or optional domain, e.g. physical and psychological health.

Some examples of the skills and qualities can be found in Table 6 of the report UNESCO [15], which, for the sake of readers’ understanding, has been adopted and will be represented in table 1.

TABLE I. COMPONENTS OF TRANSVERSAL COMPETENCES

Skills	Details
critical and innovative thinking	creativity, entrepreneurship, resourcefulness, application skills, reflective thinking, reasoned decision-making
interpersonal skills	communication skills, organizational skills, teamwork, collaboration, sociability, collegiality, empathy, compassion
intrapersonal skills	Self-discipline, ability to learn independently, flexibility and adaptability, self-awareness, perseverance, self-motivation, compassion, integrity, risk-taking, self-respect

Table 1. Cont.

Skills	Details
global citizenship	awareness, tolerance, openness, responsibility, respect for diversity, ethical understanding, intercultural understanding, ability to resolve conflicts, democratic participation, conflict resolution, respect for the environment, national identity, sense of belonging
information and media literacy	ability to locate and access information through ICT, media, libraries and archives, express and communicate ideas through ICT, use media and ICT to participate in democratic processes, ability to analyse and evaluate media content
others or optional domain	Healthy lifestyle, healthy feeding, physical fitness, empathy, self-respect

These coverages of transversal competencies definition seem to include the other two layers such as ICTC and SRLI. However, for the sake of coverage appropriateness in the two layers to include the pedagogical sense in the concepts, they have been developed in separate layers.

The second layer is ICTC, i.e. Information and Communication Technology Cultivation. This is placed as the second layer due to its role as a system support for the other layers (SRLI, CSM, and ICTC, and TCD too). However, due to its function as spiritual generator, TCD has been selected to be the basis for all of the layers. Hence, based on the developed transversal competences, a habituation in living with digital tools and facilities is cultivated. In other words, ICTC is developed to serve as a program of cultivating the habit of making the best use of all digital procedures (access, manage, integrate, evaluate, analyze and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process).

Upon the developed transversal competences and cultivated ICT competences, self-regulated learning competences are inculcated. This is intended to help students develop self-development, self-motivation, self-monitor, and self-control of their own learning [16,17], through the development of metacognitive strategies, motivation, and active participation [18]. As has been stated elsewhere [12], SRL has been implemented in various contexts and curriculum subjects such as in elementary school [19], high school [20], and college [21,22], even in the context of education for students with learning disability [23]; in mathematics [24-28].

The last layer is the focus of the model, i.e. Curriculum Subject Matters (CSM). All curriculum subject matters may fit in with SMEMFLE I 4.0 DE. They will have different names begin with SM and end up with DE. For example, in English language teaching, the name is SMELT I 4.0 DE, standing for Synergetic Multilayered English Language Teaching in Industry 4.0 and Disruptive Era, in the teaching of Bahasa Indonesia (Indonesian Language), it is SMILE I 4.0 DE, in math, it may be SMMT I 4.0 DE, etc. To give a clear idea on how the four layers of SMEMFLE I 4.0 DE are synergetically constructed, see Figure 1.

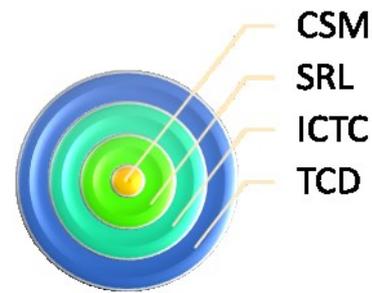


Fig. 1. Layers of SMEMFLE I 4.0 DE.

Figure 1 shows how the four layers interrelate in the ways that have been previously explained. The blue circle bases both ICTC and SRL, while ICTC bases SRL. In this perspective, TCD serves to develop such foundational competence as responsibility, discipline, honesty, fairness, hardworking, confidence, and any other transversal competences. On this foundation, ICTC and SRL are to be developed, which in turn is intended to develop, echoing [8], ‘the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process.’ Likewise, this foundation is also responsible for the development of, following the same pattern as [8], ‘the awareness, attitude and ability of individuals to appropriately self-select appropriate materials for the purposes specific to their interest and future life. Self-selection is critical as far as 21<sup>st</sup> century learning is concerned. “What you majored in will not determine your job or your career [2].” To survive, individuals need to undergo a variety of experience different cognitive processing strategies so that they can develop the so-called ‘cognitive flexibility’ to equip themselves with the ability to adapt to new and unexpected situations [2,29]. This kind of ability is key to survival in this disruptive era. To give readers clearer ideas on the three layers, concise overview of each of the three layers will be presented in the following sections. The presentation, however, will be in this order: ICTC, SRL, TCD, and ELT. This is because, although each layer has TCD-ICTC-SRL-ELT interrelationship; in practice, ICTC facilitates both SRL and TCD. In the meantime, SRL may facilitate students’ understanding of and help implement TCD and ICTC in their learning activities, and all the three facilitate the core (ELT).

### III. PREVIOUS RESEARCH FINDINGS

#### A. ICTC

The cultivation of ICT into ELT, as has been suggested in the previous section, is a must. The term cultivation has been intentionally used to highlight the significance of learners’ comfortable living as “digital residents [30], who are accustomed to accomplishing their daily and academic, and, in some cases, professional routines with ICT.” In today’s context, cultivating ICT into ELT is potentially easier because the majority of today’s students are digital natives [31].

However, serious efforts need to be done because being digital natives does not guarantee their being digital residents when it comes to the use of ICT for learning or academic purposes [10,12]. Hence, cultivation, not merely integration, is of high urgency as far as ICT for education is concerned. This term has been intentionally chosen to represent this broader sense of ICT significance in education.

Up to the time this paper is written, research findings under this term are very rare. However, for the sake of finding relevant bases for this study, those under the headings of ICT integration or ICT in education have been reviewed and will be presented in the following section.

The benefits of digital technology in education [32-38], for example, [32] investigated the use of YouTube in K12 contexts. They found that YouTube encourage student's engagement; while [33] is concerned with new media literacy in urban education, and found that new media literacies are crucial practices toward youth cultural production and participatory politics, and offers insights into the centrality of pedagogy in the politics of knowledge production.

In the meantime, [34] concerns the evolution of the modern university, significant challenges, and shifts in the framework that universities must understand and embrace. He suggests that universities that aspire to be world class will need uncommon wisdom as a response to the changing nature of the challenges faced by the universities. In addition, [35] is dealt with the development of mobile literacy, and [36] with linking digital experience with the science of learning through analytics; while [37] is concerned with Institutional Strategy and Support for Collaborative eLearning, and [38] with user-centered learning analytics in higher education.

The series of sustainable and consistent efforts on developing, researching, and creating new innovations on the basis of digital technology as shown by the aforementioned works confirms the centrality of digital literacy in this century's education. Hence, incorporating ICTC into SMEMFLE I 4.0 DE is imperative.

### *B. Self-regulated Learning Development (SRLD)*

The second layer that needs to be taken into consideration is Self-regulated Learning development (SRLD). This layer, as has been stated earlier, is also fundamental for 21<sup>st</sup> century world and I.4.0 [39-41], at least for the following reasons. First, SRL allows students to develop autonomy and control over their own learning [42-46], and hence, they may experience different cognitive processes, learn different topics, and develop different networks. This will give rooms to the development of cognitive flexibility as well as learning independence. SRL can be expected to develop the core element of cognitive flexibility, i.e. the ability to adapt to new and unexpected situations which characterize I.4.0. In the meantime, independent or autonomous learning developed along the development of SRL is critical for lifelong learning, which is also the characteristic trait of today's world [2,45].

SRL has been defined in many ways and associated with many other concepts such as metacognition, motivation, and emotion [47-50]. However, almost all definitions have in its

metacognition, motivation and emotion. In explaining the nature of SRL and its association with other learning variables, many models have been proposed and developed [51]. Barry Zimmerman developed three different models, i.e. Triadic Analysis of SRL, Cyclical Phases of SRL, and Multi-Level Model; Monique Boekaerts developed two model, including Structural and Adaptable Learning Models; Phil Winne and Allyson Hadwin developed the so-called COPES; Pintrich developed four phase model; Anastasia Efklides developed MASRL; and Allyson Hadwin, Sanna Järvelä and M. Miller developed SSRL Model. For the purpose of this article, only that of Hadwin, Järvelä and Miller will be discussed in sufficient detail in the following section.

Experts come with different number of phases in their SRL models. For example, [22] and [44] present four phases. Zimmermann proposed (1) forethought, (2) performance, and (3) self-reflection; [22] proposed (1) Forethought, planning and activation; (2) Monitoring; (3) Control; and (4) Reaction and reflection; while [44] use the following labels for their four phases: (1) *task definition*, (2) *goal setting and planning*, (3) *enacting study tactics and strategies*, and (4) *metacognitively adapting studying*. In the meantime, Boekaerts [52] proposed (1) identification, (2) interpretation, (3) primary and secondary appraisal, (4) goal setting, (5) goal striving, and (6) performance feedback. However, [53] concluded that all the phases suggested the aforementioned experts essentially can be mapped into the three phases: preparatory, performance, and appraisal [47]. Preparatory includes task analysis, planning, activation of goals, and setting goals; performance includes the actual task, monitoring and controlling the progress of performance; and appraisal includes student's reflection, regulation, and adaptation for future performances.

In classroom teaching, SRL is believed to be determinants of students' success [39,48,54]. This is indicated by such research findings as those reported by [41,49,52,55]. In the meantime, [41] investigated good metacognitive and SRL behaviors in the context of a training simulator in a curriculum setting, and found that high ROC students were shown to more extensively monitor and evaluate their own learning and to take more notes in the simulator, and a trend of higher learning performance being associated with higher SRL abilities. In addition, [49] explored the manner in which Latino students acquiring English at the elementary level developed their SRL strategies in both the urban classrooms they attended and their home communities situated within the Southeastern region of the United States. They found that the most commonly used SRL strategies employed by all of the participants and across different learning contexts included: seeking social assistance, seeking information, and environmental structuring. In addition, they also found a great variation in children's access to SRL strategies. In the meantime, [52] investigating children's SRL, found that the children enrolled in the Yellow's trials and tribulations project reported that they enjoyed participating, and at the end they all wrote an e-mail to "yellow" talking about their experience.

Reading all the literature discussed in the previous paragraphs, it is then reasonable to argue that SRLD is not only critical for 21<sup>st</sup> century independent, autonomous, critical, and

empowered learners, but also imperative in ICT-based society. Hence, incorporating SRLD into I 4.0-oriented educational model is imperative.

**C. Transversal Competence Development (TCD)**

The third layer is transversal competence development. This term is proposed and adopted in the 2013 Asia Pacific ERI-Net annual meeting [15] to refer to “skills, competencies, values, and attitudes required for the holistic development of learners, such as: collaboration, self-discipline, resourcefulness, and respect for the environment” [15]. This term was suggested to serve as an agreed term to refer to diverse terms used by different countries, economies, and organizations such as “21st century skills” or “21st century learning” (e.g. ATC21S, P2), “key competencies”, “non-cognitive skills” (The Philippine), “character education” (Republic of Korea) and “cross curriculum skills or generic skills” (Hong Kong” [15]. As suggested by the report, however, the term is by no means fixed, but rather “will need to be continuously revisited as the concept continues to evolve” [15]. In fact, it has continuously been revised along its development. In 2014, UNESCO took it as consisting of five domains, including: (1) critical and innovative thinking, (2) inter-personal skills (e.g. presentation and communication skills, organizational skills, teamwork, etc.), (3) intra-personal skills (e.g. self-discipline, enthusiasm, perseverance, self-motivation, etc.), (4) global citizenship (e.g. tolerance, openness, respect for diversity, intercultural understanding, etc.), and (5) media and information literacy such as the ability to locate and access information, as well as to analyse and evaluate media content [51], and in 2016, UNESCO added to the list the sixth domain, i.e. others, to include “competencies, such as physical health or religious values, that may not fall into one of the other.” [52].

In the tentative framework of working definition suggested by UNESCO, each domain is drafted to consist of some key characteristics. To help readers, the table presented in [15] has been taken and represented in Table 1. As it is clear in the table, TC is concerned with non-academic or non-cognitive skills or qualities. Qualities such as creativity, entrepreneurship, resourcefulness, application skills, reflective thinking, and reasoned decision-making are of course very important for students’ life, especially in their future life, both in personal and professional life. This is also the case for presentation and communication skills, leadership, organizational skills, teamwork, collaboration, initiative, sociability, collegiality, and self-discipline, enthusiasm, perseverance, self-motivation, compassion, integrity, commitment. With all these qualities, students may be expected to have brighter and more successful and sustainable future.

In the meantime, awareness, tolerance, openness, respect for diversity, intercultural understanding, ability to resolve conflicts, civic/political participation, conflict resolution, respect for the environment add to the success capacity in living in broader contexts of national and international interaction. The last domain of qualities, healthy lifestyle, healthy feeding, physical fitness, empathy, and self-respect may give them guarantee to have a longer and healthier life. Learning from the significance of these qualities in excellent

life, it is imperative that teaching program be developed by incorporating the qualities in students’ development.

TABLE II. UNESCO’S WORKING DEFINITION OF TRANSVERSAL COMPETENCES

Domains	Examples of Key Characteristics
Critical and innovative thinking	Creativity, entrepreneurship, resourcefulness, application skills, reflective thinking, reasoned decision-making
Inter-personal skills	Presentation and communication skills, leadership, organizational skills, teamwork, collaboration, initiative, sociability, collegiality
Intra-personal skills	Self-discipline, enthusiasm, perseverance, self-motivation, compassion, integrity, commitment
Global citizenship	Awareness, tolerance, openness, respect for diversity, intercultural understanding, ability to resolve conflicts, civic/political participation, conflict resolution, respect for the environment
Optional domain: (Example) Physical and psychological health	Healthy lifestyle, healthy feeding, physical fitness, empathy, self-respect

In terms of the modes of TC incorporation into education, [52] noted three possible modes, including:

- **Specific Subject:** Learning of transversal competencies is included as a well-defined entity within the formal curriculum, for example, a subject with specific goals and syllabuses for formal teaching.
- **Cross Subject:** Learning of transversal competencies runs across, infiltrates and/or underpins all “vertical subjects”, i.e. traditional school subjects.
- **Extra-Curricular:** Learning of transversal competencies is made part of school life and embedded purposefully in all types of non-classroom activities.

Each of the three modes has its own context of appropriateness depending on the goal that the institutions that implement the TCD.

In practice, teaching programs that take SMEMFLE I 4.0 DE as the basis will need careful and thoughtful considerations if good success is being targeted. SMELT I 4.0 DE, standing for Synergetic Multi-layered English Language Teaching for I 4.6 DE being piloted in Universitas Pendidikan Indonesia Senior High Labschool, may serve as an example of a practical implementation of the model. However, it needs more than this paper’s limit to discuss the results. Hence, for the purpose of this paper, suffice it to say that SMEMFLE I 4.0 DE is theoretically plausible, and its promising results may be seen in some preliminary data shown by the piloting stage of SMELT I 4.0 DE, reported in different papers [56,57].

**IV. CONCLUDING REMARKS**

This paper has explained the nature, the significance, and the explication of SMEMFLE I 4.0 DE which is designed to develop an education model for learning excellence,

synergetically interweaving the subject matter with ICT (Information and Communication Technology), SRL (Self-regulated Learning), and TC (Transversal Competences). This model is not only plausible but also enlightening, and may be applied in any subject matter in the curriculum. A pilot study in implementing the model has been initiated in the teaching of English as a foreign language in Universitas Pendidikan Indonesia Senior High Labschool. Comprehensive result of the implementation is yet to be waited at least till the end of this year.

#### ACKNOWLEDGEMENT

Parts of this writing have been made possible by the supports of Indonesia University of Education School of Postgraduate Studies, Lab-school Principals and English teachers, and their students.

#### REFERENCES

- [1] H. Hocheng, Crossing-Border Journey of E-Learning in Higher Education [Online]. Retrieved from: [http://ms.ntub.edu.tw/~elfa2018/call\\_for\\_PPT/0524%20Prof.%20Hong%20Hocheng-Crossing-Border%20Journey%20of%20E-Learning%20in%20Higher%20Education.pdf](http://ms.ntub.edu.tw/~elfa2018/call_for_PPT/0524%20Prof.%20Hong%20Hocheng-Crossing-Border%20Journey%20of%20E-Learning%20in%20Higher%20Education.pdf). Accessed on 20 November 2018.
- [2] N.W. Gleason, Higher Education in the Era of the Fourth Industrial Revolution. Singapore: Palgrave Macmillan, 2018.
- [3] A. Najam, Foreword for N. W. Gleason, Ed., Higher Education in the Era of the Fourth Industrial Revolution. Singapore: Palgrave Macmillan, 2018.
- [4] P. Lewis, Globalizing the Liberal Arts: Twenty-First-Century Education. In N. W. Gleason, Ed., Higher Education in the Era of the Fourth Industrial Revolution. Singapore: Palgrave Macmillan, 2018.
- [5] B.R. Jones and S.L. Flannigan, "Connecting the Digital Dots: Literacy of the 21 Century," *Educause Quarterly*, no. 2, pp. 1-10, 2006.
- [6] B. Trilling and C. Fadel, 21st Century Skills, Learning for Life in Our Times. San Fransisco: Jossey-Bass, 2009.
- [7] H. Beetham and R. Sharpe, Rethinking Pedagogy for a Digital Age: Designing for 21st Century Learning. New York: Routledge, 2013.
- [8] A. Martin and J. Grudziecki, "DigEuLit: Concepts and Tools for Digital Literacy Development," *Innovation in Teaching and Learning in Information and Computer Sciences*, vol. 5, no. 4, pp. 249-267, 2006.
- [9] D. Suherdi, Pendidikan Bahasa bagi Keunggulan Bangsa Keniscayaan Rekonstruksi Pendidikan Bahasa dalam Pembelajaran Abad Ke-21. Bandung: UPI Press, 2016.
- [10] D. Suherdi, "Towards the Establishment of Teachers' Multicontext Information and Communication Technology (ICT) Trainings," *ELT Tech Journal of English Language and Technology*, vol. 1, no. 1, pp. 1-11, October 2017.
- [11] D. Suherdi, English Teacher Education for the 21<sup>st</sup> Century Indonesia synergizing achievement and character education. Bandung: UPI Press, 2017.
- [12] D. Suherdi, Helping Adolescent Learners Take Good Advantages of Being ICT Digital Natives for Effective Learning, unpublished.
- [13] R. Soetaert and B. Bonamie, "Reconstructing the Teaching of Language: A View Informed by the Problems of Traditional Literacy in a Digital Age," *Journal of Information Technology for Teacher Education*, vol. 8, no. 2, pp. 123-149, 1999.
- [14] Y. Zhao, K. Pugh, S. Sheldon, and J.L. Byers, "Conditions for Classroom Technology Innovations," *Teachers College Record*, vol. 104, no. 3, pp. 482-515, April 2002.
- [15] UNESCO, 2013 Asia-Pacific Education Research Institutes Network (ERI-Net) Regional Study on Transversal Competencies in Education Policy and Practice. Paris: Bangkok UNESCO Office, 2015.
- [16] N.E. Perry, L. Phillips, and L.R. Hutchinson, "Preparing Student Teachers to Support for SelfRegulated Learning," *Elementary School Journal*, 106, pp. 237-254, 2006.
- [17] B. Zimmerman and D. Schunk, Motivation: An Essential Dimension of Self-Regulated Learning. In B. Zimmerman & D. Schunk, Eds., *Motivation and Self-Regulated Learning: Theory, Research and Applications* (pp. 1-30). New York: Lawrence Erlbaum Associates, Publishers, 2008.
- [18] W. Schneider, "The development of metacognitive knowledge in children and adolescents: Major trends and implications for education," *Mind, Brain, and Education*, vol. 2, no. 3, pp. 114-121, August 2008.
- [19] C. Dignath, G. Buettner, H. Langfeldt, How can primary school students learn selfregulated learning strategies most effectively? A meta-analysis on self-regulation training programmes. *Educational Psychology Review*, 3, pp. 101-129, December 2008.
- [20] T. Cleary, P. Platten, and A. Nelson, "Effectiveness of the self-regulation empowerment program with urban high school students," *Journal of Advanced Academics*, 20, pp. 70-107, Fall 2008.
- [21] S.W. Vanderstoep and P.R. Pintrich, *Learning to Learn: The Skill and Will of College Success*. London: Pearson, 2003.
- [22] P.R. Pintrich, "A conceptual framework for assessing motivation and self-regulated learning in college students," *Educ. Psychol. Rev.* 16, pp. 385-407, December 2004.
- [23] D. Butler, "Structuring instruction to promote self-regulated learning by adolescents and adults with learning disabilities," *Exceptionality*, vol. 11, pp. 39-60, 2003.
- [24] V.E. De Corte and P. Op 'T Eynde, "Self-regulation: A characteristic and goal of mathematics education. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 687-726). San Diego: Academic Press, 2000.
- [25] F. Perels, C., Dignath, and B. Schmitz, "Is it possible to improve mathematical achievement by means of self-regulation strategies? Evaluation of an intervention in regular math classes," *European Journal of Psychology of Education*, 24, pp. 17-31, March 2009.
- [26] B. Saddler, S. Moran, S. Graham, and K. Harris, Preventing writing difficulties: The effects of planning strategy instruction on the writing performance of struggling writers. *Exceptionality*, 12, pp. 3-17, March 2004.
- [27] A. Taboada, S.M. Tonks, A. Wigfield, and J.T. Guthrie, *Reading and Writing: An Interdisciplinary Journal*, vol. 22, no. 1, pp. 85-106, 2009.
- [28] A. Wigfield, J. Guthrie, K. Perencevich, A. Taboada, S. Klauda, A. McRae, and P. Barbosa, Role of reading engagement in mediating effects of reading comprehension instruction on reading outcomes. *Psychology in the Schools*, 45, pp. 432-445, 2008.
- [29] J.J. Canas, J.F. Quesada, A. Antoli, and I. Fajardo, "Flexibility and adaptability to environmental changes in dynamic complex problem solving tasks," *Ergonomics*, vol. 46, no. 5, pp. 482-501. April 15, 2003.
- [30] D.S. White, and A. Le Cornu, "Residents and Visitors: a new typology of online engagement," *First Monday Peer Reviewed Journal on the Internet*, vol. 16, no. 9, pp. 1-11, 5 September 2011.
- [31] M. Prensky, "Digital Natives, Digital Immigrants," *On the Horizon*, vol. 9, no. 5, pp. 1-6, October 2001.
- [32] H. Haugsbakken, and I. Langseth, "YouTubing: Challenging traditional literacies and encouraging self-organization and connecting in a connectivist approach to learning in the K-12 system," *Digital Culture & Education*, vol. 6, no. 2, pp. 133-151, 2014.
- [33] K. Jocson, New media literacies as social action: The centrality of pedagogy in the politics of knowledge production. *Curriculum Inquiry*, 45, pp. 30-51, February 2015.
- [34] L. Johnson, From Good to Great - Uncommon Leadership in These Uncertain Times, unpublished.
- [35] M. Pegrum, Developing Mobile Literacy, unpublished.
- [36] D. Gibson, Linking digital experience with the science of learning through analytics, unpublished.
- [37] A. Fein, Institutional Strategy and Support for Collaborative eLearning, unpublished.

- [38] H. Ogata, Towards User-centered Learning Analytics in Higher Education, unpublished.
- [39] S. Zunbrumm, J. Tadlock, and E. D. Roberts, Encouraging Self-Regulated Learning in the Classroom: A Review of the Literature. Metropolitan Educational Research Consortium (MERC), Virginia Commonwealth University [Online]. Retrieved from [http://www.self-regulation.ca/uploads/5/6/2/6/56264915/encouraging\\_self\\_regulated\\_learning\\_in\\_the\\_classroom.pdf](http://www.self-regulation.ca/uploads/5/6/2/6/56264915/encouraging_self_regulated_learning_in_the_classroom.pdf). Accessed on 20 November 2018.
- [40] D. C. Moos and A. Ringdal, "Self-Regulated Learning in the Classroom: A Literature Review on the Teacher's Role," *Education Research International* Volume, Article ID 423284, 15 pages, 2012.
- [41] C.M. Steiner, G. Wesiak, A. Moore, O. Conlan, D. Dagger, G. Donohoe, and D. Albert, An Investigation of Successful Self-Regulated-Learning in a Technology-Enhanced Learning Environment. Retrieved from <https://www.researchgate.net/publication/257933970>. Accessed on 20 November 2018, 2013.
- [42] B.J. Zimmerman, Attainment of self-regulation: A social cognitive perspective. In M. Boekaerts, P.R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation*. San Diego, CA: Academic Press, pp. 13-39, 2000.
- [43] B.J. Zimmerman, "From cognitive modeling to self-regulation: a social cognitive career path," *Educational Psychology*, vol. 48, pp. 135-147, 2013.
- [44] P.H. Winne and A.F. Hadwin, "Studying as self-regulated engagement in learning, in *Metacognition in Educational Theory and Practice* eds D. Hacker, J. Dunlosky, A. Graesser, editors. Hillsdale, NJ: Erlbaum, pp. 277-304, 1998.
- [45] A.F. Hadwin, M. Oshige, C.L.Z. Gress, and P.H. Winne, "Innovative ways for using gStudy to orchestrate and research social aspects of self-regulated learning," *Computers in Human Behavior* 26, pp. 794-805, 2010.
- [46] A. Efklides, "Interactions of metacognition with motivation and affect in self-regulated learning: the MASRL model," *Educational Psychology*, vol. 46, pp. 6-25, 2011.
- [47] E. Panadero, "A Review of Self-regulated Learning: Six Models and Four Directions for Research," *Front Psychology*, vol. 8, pp. 422, 2017.
- [48] S.J. Pape and C. Wang, "Middle school children's strategic behavior: Classification and relation to academic achievement and mathematical problem solving," *Instructional Science*, vol. 31, no. 6, pp. 419-449, 2003.
- [49] C. Wang, L. Quach, and J. Rolston, "Understanding English language learners' self-regulated learning strategies: Case studies of Chinese children in U.S. classrooms and home communities," *New perspectives on Asian American parents, students, and teacher recruitment*, pp. 73-99, 2009.
- [50] P. Rosário, J.C. Núñez, A. Valle, J. González-Pianda, and A. Lourenço, "Grade level, study time, and grade retention and their effects on motivation, self-regulated learning strategies, and mathematics achievement: a structural equation model," *European Journal of Psychology of Education*, vol. 28, no. 4, pp. 1311-1331, December 2013.
- [51] UNESCO, *Education Policy Brief Skills for Holistic Human Development*. Paris: Bangkok UNESCO Office, 2014.
- [52] M. Puustinen and L. Pulkkinen, "Models of self-regulated learning: a review," *Scandinavian Journal of Educational Research*, vol. 45, pp. 269-286, Aug 2001.
- [53] M. Boekaerts and L. Corno, "Self-regulation in the classroom: a perspective on assessment and intervention," *Applied Psychology*, vol. 54, pp. 199-231, March 2005.
- [54] UNESCO, *Assessment of Transversal Competencies Policy and Practice in the Asia Paifi Region*. Paris: Bangkok UNESCO Office, 2016.
- [55] S. Çelik, E. Arkin, and D. Sabriler, "EFL learners' use of ICT for self-regulated learning," *The Journal of Language and Linguistic Studies*, vol. 8, no. 2, pp. 98-118, 2012.
- [56] D. Suherdi, "SMSLEFA: An alternative synergistic multilayered analysis of students' learning engagement in EFL context," *Indonesian Journal of Applied Linguistics*, vol. 8, no. 1, pp. 11-20, May 2018.
- [57] D. Suherdi, *Teaching English in the Industry I 4.0 and Disruption Era: Early Lessons from the Implementation of SMELT I 4.0 DE in an UPI Senior High Lab School Class*, unpublished.