

## Cognitive Green Skills Competency in The Fourth Revolution Industries

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### Abstract

*The Fourth Industrial Revolution (4IR) for Sustainable Development aims to highlight the potential of technologies and their most critical needs in the world in terms of environmental, social and economic challenges, with a view to promoting sustainable development and enhancing human capacity. Therefore, Green Skills are the key to turning Fourth Industrial Revolution (4IR) into a low-carbon economy and innovation. Cognitive Green Skills is one of the competencies that essential to the driving force behind effective teaching and learning. The goal of this study is therefore to analyze the level of cognitive green skills in 4IR among TVET teachers and educators at the Institute of Teacher Education. A quantitative survey in the form of a questionnaire using Google Form is used as an instrument for the purpose of this study. 5-point Likert scale is employed to help the respondent give appropriate answers. A total of 201 teacher trainees and 44 educators were responses as a sample in this study. The questionnaire was developed and adapted from the Model of Green Skills Competence and Skills in 4IR, consisting of ten indicators. A descriptive statistic such as mean score and standard deviation for statistical measurement was used to report the findings. Finding from the analysis shows that the level of cognitive green skill competencies amongst TVET teacher trainee are at a moderate level and educators are at a high level. Result of this study will be shared with Institute of Teacher Education which may use to improve the cognitive green skills of TVET teacher trainee so that when they become a teacher, they will share their cognitive competencies green skills and be a role model in shaping future generations to benefit mankind, environment and economy.*

**Keyword:** Sustainable Development, Fourth Industrial Revolution (4IR), Green Skills; Cognitive Competency.

## Introduction

As the Industries of the Fourth Revolution (4IR) speeds up, technology is becoming faster, more efficient and more available than ever before. Technology is also increasingly interlinked; in particular, we are seeing a convergence of the digital, physical and biological realms. New technologies make social changes possible by impacting the economies, beliefs, personalities and capacity of future generations (Ruohomaa, Kantola & Salminen, 2018). The 4IR for sustainable development is designed to demonstrate the potential of Innovations of the Fourth Industrial Revolution and their applications to the most pressing environmental issues in the world (Oosthuizen,2017).

Education for Sustainable Development (ESD) is described by UNESCO-UNEVOC (2017) as an education that promotes changes in knowledge , skills , values and attitudes towards a more prosperous and equitable society. Consequently, ESD as a program to achieve sustainable development (Hensley, 2017) and Green Skills become a gateway to turning Fourth Industrial Revolution into a low-carbon economy and innovation (4IR)(Mansell, Philbin & Konstantinou,2019).

Thus, the purpose of the study is to identify the level of cognitive competency green skills in the fourth revolution industries from the perspective of TVET teacher trainee and educators.

## Literature Review

The Greening TVET study in Vietnam needs teachers to be educated about green issues OF TVET (Klaus-Dieter & Huyen, 2016). Due to the lack of qualified teachers in TVET, teachers must be provided with green skills specifications, such as technological skills and expertise, pedagogical elements, work experience and appropriate environmental knowledge. They also required teaching and inculcating green skills in order to raise the environmental awareness of their students. Besides that, report from UNESCO-UNEVOC (2014) on the challenges faced by the Tanzanian State where the levels of awareness towards the implementation of green skills in TVET education among TVET teacher in the country are at a low level. While a study conducted by Mukoni (2015) on 100 teachers in Gweru, Zimbabwe found that the knowledge of environmental education received in the school curriculum had no effect on social change for the community, students and teachers. Meanwhile, the qualitative research to identify teachers' knowledge of sustainable development education (Education for Sustainable Development-ESD) implemented through the Environmental Education Sustainability Program (SLAAS) that conducted by Mahat et al. (2017), the analysis results shows that the concept of sustainability is not understood and the basics of teacher knowledge are weak. In addition, the findings from the interviews of the teachers found that the activities are undertaken only as a Sustainable School Program assessment and no continuity to achieve sustainability. The scope of teacher knowledge is relatively minimal to the aspect of the environment only and was not integrated with social or economic dimensions.

Moreover, a study conducted by Lee, Muhtar & Lai (2018), on green knowledge among students of the TVET Master program at UTHM found that knowledge of green practice among students was at the mean level of 1.17 which are at a low level. Besides that, Mohd Zailani & Mohamad Khairi (2017) in their study to identify 21st century pedagogical practices amongst trainee teachers found that system analysis aspects recorded the lowest mean (4.37) compared to aspects of creative thinking, collaborative learning, and communication. This reinforce with the findings from study of Fatimah Mustaffa & Mohd Ali (2017) about sport risk management practices amongst teacher trainee, analysis also found that the practice of managing sports risk management will be enhanced with coaches competent in cognitive, skills and attitudes. Furthermore, a study conducted by Nor'Azah & Shamsiah (2016) to determine the level of high order thinking skills among trainee teachers showing that the level of high order thinking skills among trainee teachers was at a moderate level (mean = 2.83). This situation needs to improve as some of them are teachers in the service while some of them are teacher trainee. Competent educators can cause result in effective teaching and learning of the student (Roslan Abu Hassan, 2014). Teacher competence including matters relating to personal, technical and social teaching, subject matter expertise, teaching and learning theory expertise, group learning process management, adaptation and personality management ((Mohd Jalil, Noor Hisham & Annas Akhmal, 2015).

Therefore, in developing educational sustainability, teachers must have cognitive green skills in ensuring that the teaching and learning process is smooth. For example, in the subject of TVET, Technology Design, competent teachers in the cognitive green skills of green will expose to the students on how to manage solid waste systematically so that it will reduce the index of carbon dioxide emissions produced by humans into the air (Alwi, Kamis & Rus 2017). Hence, the focus of this paper is to identify the level of cognitive green skills in Fourth Industrial Revolution (4IR) from the perspectives of TVET teacher trainee and TVET lecturer since they are playing a crucial role in achieving the Sustainable Development Goals (SDGs) 2030 for quality education as a prerequisite for sustainable learning and human development.

**Conceptual Framework**

The conceptual framework of this article is connected to this article's related literature. Below is a conceptual structure diagram, which will be discussed in this article.

**Model of Green Skills Competency**

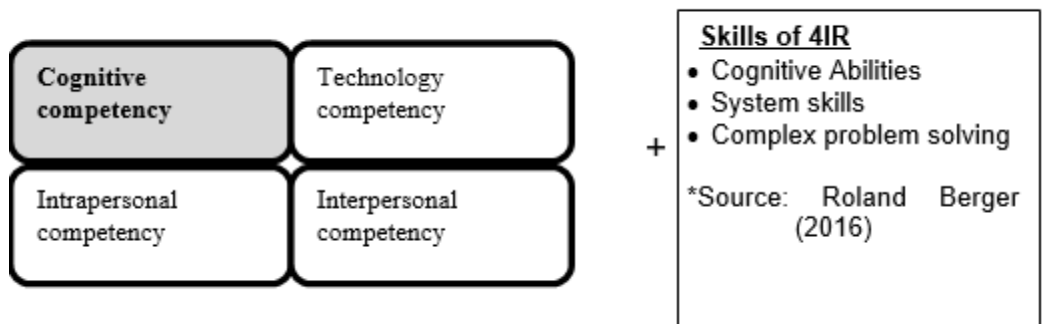


Figure 1: Model of Green Skills Competency

Model of Green Skills Competency requires a balanced of four competencies which are cognitive competency, technology competency, intrapersonal competency and interpersonal competency. However, in this study it just focuses on cognitive competency. In cognitive competence, the elements of the construct are environmental awareness and the willingness to learn about sustainable development; risk analysis skills; innovation skills to identify opportunities and create new strategies to address green challenges; solving problems on economic, social and green issues; and innovative solutions for green strategies (Pavlova, 2016). According to Mohd Jalil, Noor Hisham & Annas Akhmal (2015), teacher competencies consist of personal, professional and social related topics such as teaching, subject matter expertise, theory-based teaching and learning, managing learning processes, adapting to community and personality. Therefore, in developing educational sustainability, teachers must have the cognitive skills in ensuring that the teaching and learning process is smooth.

In top of that, from the Model of Green Skills Competency, cognitive competency is one of the important aspects of green skills development (Pavlova, 2016). Cognitive competence is a thinking ability that encompasses the ability to receive, process, integrates and respond to information (Uma G.Soman, 2015). According to Pavlova (2016), cognitive competencies in green skills encompasses elements of environmental awareness and readiness in the development of sustainable development; have skills in risk analysis to evaluate and interpret environmental, economic and social changes; innovation skills to identify opportunities and create new strategies for responding to green challenges and how to solve problems in the green environment; how to think about different things; the skills of how to deal with complexity and the relationship between one thing and another. Therefore, the cognitive competencies in green skills are important to proficient by TVET teachers or educators.

However, this study also integrates the basis of the industrial revolution 4.0 to produce a variety of green skills competencies based on new technologies that impact on various disciplines, economies and industries. In the Industrial Revolution 4.0, Wilfried Aulbur, CJ & Bigghe (2016 ) stressed three main skills that are cognitive abilities, system skills and complex problem-solving skills. The top three skills are projected to be high in demand, which will remain important. In conjunction, all these skills are embedded in the Model of Green Skills Competency. Thus, it is emerging to combine and rephrase those skills to develop the indicator of items.

## **Methodology**

This study was a kind of survey research design to assess teacher trainees and educators' perspectives on the level of cognitive green skills in the fourth revolution industry. This study used quantitative approach whereby questionnaires were distributed to the respondents using Google Form. The assessment is based on a quantitative method using statistical procedures. Quantitative work can be conducted using descriptive or inferential studies (Chua, 2015). For reporting the results, Chua (2015) published simple descriptive statistics such as frequency, percentage, mean, standard deviation, and scoring distribution. Data from the questionnaire were obtained in this study, and the mean and standard deviation scores were used to answer research questions.

The population consisted of TVET teacher trainee and educators at Institute of Teacher Education in Malaysia. Of the 27 campus, there are three campus that offer TVET courses which are Institute of Teacher Education Tuanku Bainun Campus, Institute of Teacher Education Temenggong Ibrahim Campus dan Institute of Teacher Education Technical Education Campus. The sampling process was performed by a disproportionate stratified random technique. Raosoft Software has been used to get the minimum sample from the population targeted.

From the 202 TVET teacher trainee surveyed, 201 (99.5%) teacher trainee and 44 (93.6%) educators has responded. This response rate was adequate since it just 156 minimum sample required based on *Raosoft* Software with margin error 5% and confidence level 99%. A total of 10 questions have been used and analysed. The questionnaire has been developed and adapted from the Model of Green Skills Competency by (Pavlova 2016) and key skills in 4ir by Wilfried Aulbur, Arvind CJ (2016). The detail of how the construct in questionnaire was developed has been explained in Table 1.

Table 1: Details of Indicator developed in questionnaire

No.	Sources	Indicator	Details item in questionnaires	Scale
1.	Model of Green Skills Competency -Cognitive competency	Environmental awareness	<b>Environmental awareness:</b> to learn about sustainable development with current technology applied	Using ordinal scale: 5 point Likert scale
	4IR key skills: -system skills	Current technology applied		1- Strongly Disagree
2.	Model of Green Skills Competency -Cognitive competency	Environmental willingness	<b>Environmental willingness:</b> to learn about sustainable development with current technology applied	2- Disagree
	4IR key skills: -system skills	Current technology applied		3- Neutral
3.	Model of Green Skills Competency -Cognitive competency	Systems and risks analysis skills:	<b>Systems and risks analysis skills:</b> to assess, interpret, and understand both the need for change and the measures required	4- Agree
	4IR key skills: -system skills -complex problem solving skills			5- Strongly Agree
4.	Model of Green Skills Competency -Cognitive competency	Risk evaluation skills	<b>Risk evaluation skills:</b> to find solution about project management	
	4IR key skills: -cognitive abilities -system skills -complex problem solving skills			

5.	Model of Green Skills Competency <u>-Cognitive competency</u> 4IR key skills: -cognitive abilities - system skills	Identified green technology challenges	<b>Identified green technology challenges</b> during develop project or course work.
6.	Model of Green Skills Competency <u>-Cognitive competency</u> 4IR key skills: -cognitive abilities - problem solving skills	Innovation skills	<b>Innovation skills:</b> to identify opportunities and create new strategies to respond to green challenges
7.	Model of Green Skills Competency <u>-Cognitive competency</u> 4IR key skills: -cognitive abilities	Critical thinking	<b>Critical thinking</b> on how to think about things differently
8.	Model of Green Skills Competency <u>-Cognitive competency</u> 4IR key skills: -cognitive abilities -complex problem-solving skills	Problem solving skill	<b>Problem solving skill:</b> that can find solution related to green challenges.
9.	Model of Green Skills Competency -Cognitive competency  <u>4IR key skills:</u> -cognitive abilities	Element across curriculum	<b>Element across curriculum</b> Can relate with elements of environmental education with other topics or subject. (how everything is connected)
10.	Model of Green Skills Competency <u>-Cognitive competency</u> 4IR key skills: -cognitive abilities -complex problem solving skills	Innovative Solutions	<b>Innovative Solutions</b> Encourage students to explore issues and implement innovative solutions

Two experts from the Higher Education Institute in the technical and vocational field was carried out the face and content validity of this instrument. The reliability of this instrument was been measured with internal consistency, Cronbach Alpha coefficient 0.82. The five-point Likert scale has been used to measure the questions that represent perspectives of teacher trainee and educators towards the level of proficiency of cognitive green skills in the fourth revolution industries. Finally, basic descriptive statistic such as mean scores and standard deviation were used to report the findings. Based on the interpretive mean values proposed by Landell (1977), each element studied will be at the strength of its interpretation value indicating that the level of cognitive competency green skills in fourth industries revolution. Table 2 shows the interpretation score for cognitive competency level as below:



Table 2: Interpretation score to identify the level of cognitive competency green skills in 4ir

Mean Score	Interpretation
1.00 - 2.33	Low
2.34 - 3.67	Intermediate
3.68 - 5.00	High

## Results and Discussion

Tabulated data from Table 3 indicates that 10 components of cognitive green skills were considered to achieve the cognitive green skill competencies. The 5-point Likert scale was used in Industry Revolution 4.0 to define the level of green skills competency elements.

Table 3: The level of cognitive green skills agreeable by the respondent

No.	Items	TVET Teacher trainee			Educators		
		Mean Score (m)	Standard Deviation (SD)	Interpretation level of proficiency	Mean Score (m)	Standard Deviation (SP)	Interpretation level of proficiency
1.	<b>Environmental awareness:</b> to learn about sustainable development with current technology applied	3.74	1.026	High	4.36	0.574	High
2.	<b>Environmental willingness:</b> to learn about sustainable development with current technology applied	3.84	0.882	High	4.34	0.713	High
3.	<b>Systems and risks analysis skills:</b> to assess, interpret, and understand both the need for change and the measures required	3.31	1.142	Moderate	3.57	1.354	Moderate
4.	<b>Risk evaluation skills:</b> to find solution about project management	3.35	1.076	Moderate	3.75	1.222	High
5.	<b>Identified green technology challenges</b> during develop project or course work.	3.60	1.063	Moderate	4.09	0.936	High
6.	<b>Innovation skills:</b> to identify opportunities and create new strategies to respond to green challenges	3.55	1.076	Moderate	3.95	1.077	High
7.	<b>Critical thinking</b> on how to think about things differently	3.64	0.927	Moderate	4.25	0.892	High
8.	<b>Problem solving skill:</b> that can find solution related to green challenges.	3.77	1.038	High	4.34	0.645	High
9.	<b>Element across curriculum</b> Can relate with elements of environmental education with other topics or subject.(how everything is connected)	3.84	0.953	High	4.36	0.650	High
10.	<b>Innovative Solutions</b> Encourage students to explore issues and implement innovative solutions	3.76	0.954	High	4.41	0.583	High
	<b>Total average</b>	<b>3.64</b>	<b>1.014</b>	<b>Moderate</b>	<b>4.14</b>	<b>0.865</b>	<b>High</b>

Based on table 3, the interpretation of mean scores by Landell (1977) shows that there are five elements of cognitive green skills from the perspectives of teacher trainee are at a high level. The findings show that two elements of cognitive green skills are at the highest score means which are “Environmental willingness to learn about sustainable development with current technology applied” with mean score 3.84 (SD=0.882) and “Can relate with elements of environmental education with other topics or subject (how everything is connected)” with mean score 3.84 (SD=0.953). Meanwhile, the other five elements of cognitive green skills are at a moderate level. The lowest mean score shows that element of “Systems and risks analysis skills to assess, interpret, and understand both the need for change and the measures required” with mean score 3.31 (SD=1.142). As average, the level of cognitive green skills in fourth industrial revolution from the perspectives of TVET teacher trainee is at a moderate level.

Analysis of findings from educators’ perspectives shows that all the nine elements of cognitive green skills are at a high level. The highest score mean is the element of “Encourage students to explore issues and implement innovative solutions” with mean score 4.41 (SD=0.865). Meanwhile the element of “Systems and risks analysis skills to assess, interpret, and understand both the need for change and the measures required” are at a moderate level. Thus, the level of cognitive green skills in fourth industrial revolution from the perspectives of educators is at a high level.

## Discussion

Finding from this study shows that most of TVET teacher trainee and educators have the elements of cognitive green skills for elements of “Environmental awareness and willingness to learn about sustainable development with current technology applied”. It is realigned with the concept of Pavlova (2016) where cognitive competencies in green skills encompasses elements of environmental awareness and readiness in the development of sustainable development. However, this finding is contradicted to the report of UNESCO-UNEVOC (2014) on the challenges faced by the Tanzanian State where the levels of awareness towards the implementation of green skills in TVET education among TVET teacher in the country are at a low level. Meanwhile, the qualitative research to identify teachers' knowledge of sustainable development education (Education for Sustainable Development-ESD) implemented through the Environmental Education Sustainability Program (SLAAS) that conducted by Mahat et al. (2017), the analysis results shows that the concept of sustainability is not understood and the basics of teacher knowledge are weak. Additionally, Vietnam's Greening TVET report shows teachers need to be trained on green issues TVET (Klaus-Dieter & Huyen, 2016). Because of the shortage of qualified TVET teachers, teachers need to be trained with criteria for green skills such as technological skills and expertise, pedagogical elements, workplace experiences and also appropriate environmental knowledge. They also had to inculcate green skills to increase their students' knowledge of the environment. Nonetheless, it was suggested from the results of the study that the teachers should update their awareness about achieving sustainable development goals and strengthen their teaching skills

The element in cognitive green skills should be polish by TVET teacher trainee and educators are “Systems and risks analysis skills to assess, interpret, and understand both the need for change and the measures required” and “Risk evaluation skills to find solution about project management”. This finding corresponds with the research conducted by Mohd Zailani &



Mohamad Khairi (2017) to identify 21st century pedagogical practices amongst trainee teachers found that system analysis aspects recorded the lowest mean (4.37) compared to aspects of creative thinking, collaborative learning, and communication. This reinforces with the findings from study of Fatimah Mustaffa & Mohd Ali (2017) about sport risk management practices amongst teacher trainee, analysis also found that the practice of managing sports risk management will be enhanced with coaches competent in cognitive, skills and attitudes. Furthermore, a study conducted by Nor'Azah & Shamsiah (2016) to determine the level of high order thinking skills among trainee teachers showing that the level of high order thinking skills among trainee teachers was at a moderate level (mean = 2.83).

When the Fourth Industrial Revolution (4IR) accelerates, teachers and students need the ability to efficiently solve complex problems in real time, using a special and carefully built approach (Goals & Ngjeqari 2016). They must be able to face anything risk and know how to analyze the future obstacle in education. Therefore, the cognitive competencies in green skills are important to proficient by TVET teachers or educators. Besides this, problem-solvers can work independently from higher supervision and control. They are initiative-takers and enjoy risk, and they have no fear of dirtying their hands and making mistakes. They also learn from these mistakes and typically debrief their processes to create more efficient and cost-effective solution (Watanabe, 2016). For this reason, these skills are very important to educator as they will deliver the skills to the students.

In overall, the level of cognitive green skills amongst TVET lecturers in Fourth Industrial Revolution (4IR) are at a high level while for TVET teacher trainee are at a moderate level. It seemed perfectly reasonable result as in an increasingly competitive environment to provide better education, higher education institution should focus on improving the students' cognitive abilities. One of the important factors which can contribute in improving cognitive abilities is lecturer professional competencies. Lecturer should have a wide and deep knowledge regarding the courses they teach (Prasetio & Dindi 2017). According to Iveta, Tírpáková & Markechová (2015), cognitive abilities of lecturers are, on the one hand, the premises of lecturing behavior but, on the other hand, they are the foundation for the achievement of learning goals. The willingness of a lecturer to adapt the educational objectives to case studies or work-related issues and to look for these implementation opportunities within the instructional process is a very necessary teaching skill. To an adult learner, especially to TVET teacher trainee, this kind of application is the most suitable method of learning. For this reason, the lecturer should know how to inculcate their student (teacher trainee) to upgrade their cognitive green skills so that it will benefit future generation when they become a teacher.

## **Conclusion and Recommendations**

Green skills are a must for sustainable development to ensure the Fourth Industrial Revolution is turned into a low-carbon economy and innovation. Meanwhile, education plays the major roles in green economy skills, 4IR skills, social skills, and environmental skills development. Thus, cognitive competency is one of the important aspects of green skills development. Cognitive green skills competencies in fourth industrial revolution encompasses elements of Environmental awareness and willingness the with current technologies applied, system and risks analysis skills,

risk evaluation skills, identified green technology challenges, innovation skills, critical thinking skills, problem solving skills, element across curriculum and innovative solutions skills to solve the green challenges. For this reason, the main objective of this study was to shed some light on initial cognitive green skills in Fourth Industrial Revolution (4IR) amongst TVET teacher trainee and educators. In addition, this paper focuses on TVET teacher trainee at the Institute of Teacher Education so that it is important to concentrate on this institution as teacher trainee can share their cognitive green skills and be a role model in shaping new generations for the good of humanity, environment and economy.

## References

- Alwi, A., Kamis, A. & Rus, R. C. 2017. Green Skills : Innovation In The Subject Of Design And Technology Green Skills : Innovation In The Subject Of Design And Technology ( D & T ) (August). doi:10.17501/icedu.2017.3116
- Chua, Y. P. 2015. Kaedah dan Statistik Penyelidikan : Kaedah Penyelidikan (May): 12–14.
- Fatimah Mustaffa, Mohd Ali, & A. I. 2017. Pembentukan dan Pengujian Amalan Pengurusan Risiko Sukan Jurulatih Institut Pendidikan Guru Malaysia persepsi Atlet. *Journal IPG Temenggong Ibrahim*. Retrieved from [http://eprints.uthm.edu.my/id/eprint/6308/1/20.\\_Journal\\_IPG\\_Temenggong\\_Ibrahim.pdf](http://eprints.uthm.edu.my/id/eprint/6308/1/20._Journal_IPG_Temenggong_Ibrahim.pdf)
- Goals, D. & Ngjeqari, V. 2016. The Sustainable Vision of Industry 4 . 0.
- Hensley, N. 2017. Approaches to Education for Sustainable Development (ESD) in Kesennuma, Japan A qualitative case study of continuous challenges faced by educators pursuing sustainability in their teaching (45). Retrieved from [https://www.edu.su.se/polopoly\\_fs/1.341643.1502351334!/menu/standard/file/Hensley\\_2017\\_ICE\\_Thesis\\_Final\\_Manuscript.pdf](https://www.edu.su.se/polopoly_fs/1.341643.1502351334!/menu/standard/file/Hensley_2017_ICE_Thesis_Final_Manuscript.pdf)
- Iveta, Ž., Tírpáková, A. & Markechová, D. 2015. The analysis of professional competencies of a lecturer in adult education. doi:10.1186/s40064-015-1014-7
- Klaus-Dieter & Huyen, D. T. 2016. Greening TVET in Vietnam:Sustainable Development, Green Economy and The Role of Greening TVET. *Vietnamese-German Development Cooperation in TVET*.
- Lee, M. F., Muhtar, N. S. & Lai, C. S. 2018. Green Practice Knowledge Profiling among the Technical and Vocational Education Masters Programme Students Green Practice Knowledge Profiling among the Technical and Vocational Education Masters Programme Students.
- Mahat, H., Hashim, M., Saleh, Y., Nayan, N. & Norkhaidi, S. B. 2017. Pengetahuan Dan Amalan Hijau Dalam Kalangan Murid Sekolah Rendah. *Jurnal Pendidikan Malaysia* 42(1): 41–49.
- Mansell, A. P., Philbin, S. P. & Konstantinou, E. 2019. INFRASTRUCTURE PROJECTS ' IMPACT ON SUSTAINABLE DEVELOPMENT – CASE STUDY OF A WATER-UTILITY COMPANY. *OTMC Conference*.
- Mohd Jalil, A., Noor Hisham, J. & Annas Akhmal, H. 2015. TEVT di Malaysia : Cabaran dan Harapan. *Seminar Kebangsaan Majlis Dekan-Dekan Pendidikan Awam 2015* (October): 1–8.
- Mukoni, M. 2015. Interfacing Teacher Participation and Community Environmental Education: A Step towards Education for Sustainable Development. *International Journal of Social Science Research* 3(2): 132. doi:10.5296/ijssr.v3i2.8378
- Oosthuizen, J. 2017. The Determinants Of Fourth Industrial Revolution Leadership Dexterity : A Proposed Framework For 4ir-Intelligence And Subsequent 4ir Leadership Development (March).
- Pavlova, M. 2016. Greening skills : Research and Practices from Asia and the Pacific region To

cover. *EESA 2016, South Africa*.

- Prasetio, A. P. & Dindi, D. 2017. Lecturers ' Professional Competency and Students ' Academic Performance in Indonesia Higher Education (August). doi:10.5296/ijhrs.v7i1.10902
- Roslan Abu Hassan. 2014. Kompetensi Guru Bukan Opsyen Yang Mengajar Kemahiran.
- Ruohomaa, H., Kantola, J. & Salminen, V. 2018. Value Network Development in Industry 4 . 0 Environment. *Advances in Human Factors, Business Management and Leadership, Advances in Intelligent Systems and Computing* 1. doi:10.1007/978-3-319-60372-8
- Uma G.Soman. 2015. Cognitive Development. *An Introduction to Educating Children*, hlm. 1–12. doi:10.1093/oxfordhb/9780199958450.013.0016
- UNESCO-UNEVOC. 2017. Greening TVET curriculum and skills - Teacher Mentoring and Peer Learning Programme ( TMPLP ) (June).
- Watanabe, L. 2016. The Critical 21st Century Skills Every Student Needs and Why. *wabisabi learning*. <https://www.wabisabilearning.com/blog/skills-every-student-needs> [9 January 2020].
- Wilfried Aulbur, CJ, A. & Bigghe, R. 2016. Skill Development for Industry 4.0. *Roland Berger*.