

RESEARCH BRIEF

## Thai Vocational College Instructor Teaching Competency: A Second Order Confirmatory Factor Analysis

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Borrowing ideas outlined in the United Nations Agenda for Sustainable Development report, the Thai government has stated its intention to promote vocational study, with an aim to increase the quality of the workforce across 10 key sectors (Thailand's Voluntary National Review, 2017). These same goals are also outlined under the 12th Education Plan (2017–2021), in which the government is promoting dual education vocational study with an aim to increase the quality workforce in real sectors. This then plays an important role in human development, which can lead to the development of Thailand's society and economy (Office of the National Economic and Social Development Board, 2016).

Thailand's 12th Education Development Plan (2017–2021) also focuses on five primary goals. These include improving Thailand's education quality while enhancing an individual's ethics and morals and helping them be immune to changes at the same time contributing to Thailand's development. Additionally, strengthening the Thai workforce to enhance competitiveness is also crucial. Knowledge, technology, and innovation need to be enhanced which can then support sustainable development. Also, providing access to life-long learning is a crucial element, and finally, creating an effective education

management system by following the principles of good governance while ensuring stakeholders' engagement is important (Thailand's Voluntary National Review, 2017).

Furthermore, the importance of Technical Vocational Education and Training (TVET) in Thailand cannot be understated, and on 12 February 2016 Thai government officials announced the merger of all public and private vocational colleges. At the time of the announcement, there were a total of 886 public and private vocational colleges, with a total of 976,615 enrolled students in lower and higher vocational degrees (Hoonthong, 2015; Ministry of Education, 2016).

TVET in Thailand is provided in three forms (UNESCO, 2011). These include (1) certificate level (10th–12th grade), (2) post-secondary level (a 2-year associate degree or diploma), and (3) a bachelor's degree level program (Tongliemnak, Tharmmapornphilas, & Pumsiri, 2016). Additionally, under the new 20-year Thai educational plan, the desired ratio of vocational to general education students is projected to increase from 38:62 to 60:40, with the hope of helping meet the goals of Thailand's new digitally enabled, knowledge-based, economic model under Thailand 4.0 guidelines (Jones & Pimdee, 2017; Sermsirikarnjana, Kiddee, & Pupat, 2017).

Furthermore, vocational education, as part of the national plan for human resource development, is an important mechanism in the preparation of people to become quality citizens who can adapt to and solve a variety of problems in constantly changing situations (Thailand's Voluntary National Review, 2017). These quality citizens must also possess the capability to initiate for themselves, their families, their community, and their national development and advancement on the bases of understanding, reason, accuracy, goodness, and suitability. In Thailand, the Office of the National Education Commission (2002) further stated that educational aims should include the full development of physical and mental health, intellect, knowledge, morality, integrity, and a desirable way of life which allows people the ability to live in harmony with others.

According to UNESCO, a country's curriculum is the vehicle through which student empowerment is achieved. These elements include the necessary knowledge, skills, attitudes, and values that enable individuals to be empowered for both personal and national development. A curriculum should, therefore, meet the needs of the individual citizens and the nation (Kabita & Ji, 2017).

To manage education in the 21st century, reforms that can improve the teaching and learning process should be focused on thinking skills, communication skills, innovation, and cooperative learning (Baron, Clake, Turner, & Pass, 2010). *Cooperative learning* should be a focus of *vocational* educators, as students who focus on individual learning performance leads to poor results in a cooperative learning classroom (Tielman, den Brok, Bolhuis, & Vallejo, 2011).

Also, Reeve (2016) said that, in 21st-century education, providing an environment that encourages students to learn and think is essential. In an analysis of Thai vocational and educational training (VET), competency was expressed as a key component. Also, since the development of smartphone and the Internet technology today has a major influence on our way of life and education (Pumim, Srinuan, & Panjakajornsak, 2017), technology should be used as a tool to support students' learning (West & Bleiberg, 2013). Learning can happen anywhere and anytime through technology, and in the future, will be cloud-based (Britland, 2013). Thus, teachers need to change from teaching to

coaching, in which the teacher acts as a learning coach and a "learning travel agent," who are ready to guide students to explore the world. The future, therefore, is about access, anywhere learning and collaboration, both locally and globally.

McClelland (1973) divided competency into three elements. These elements are knowledge (such as training, seminars, and workshops), skills (such as expertise and proficiency), and attributes, (such as attitude, value, identity, and personality). In Indonesia, Tampang and Wonggo (2018) also stated the importance of vocational teacher competencies in a nation's development and felt that teachers should be facilitators, initiators, and motivators in helping graduates achieve life-long learning. Scott (2015) also detailed the need for problem-solving competency in a 21st-century workforce, which requires individuals to draw from multiple domains to find solutions to complex issues. This ability to scan multiple domains is especially valued in today's highly competitive workplace (P21, 2007).

Chonsook (2016) reported that teachers are responsible for their work, and should know how to teach effectively. They should also be able to understand the purpose of education, help in the design of the curriculum, evaluate and assess students' learning outcomes, and be able to work with parents and the community. To do so, teachers need the training to acquire knowledge and skills in teaching (Association for Career and Technical Education, 2010; Office of the National Education Commission, 2002).

From the review of the literature and policies set forth by Thailand's Office of the Vocational Education Commission [OVEC], we aimed to develop a model and evaluate vocational college teaching competency. Thus, in this study, the focus was given to identifying what elements of teaching competency the instructors should have in order to use such findings in setting policy, guidelines, or planning to enhance the teaching competency of industrial instructors in colleges. Enhancing the competencies of college vocational instructors will lead to the development of learners' knowledge and skills, and thus, a stronger nation.

The aim of the research is, therefore, to conduct a 1<sup>st</sup> and 2<sup>nd</sup> order confirmatory factor analysis (CFA) on Thai vocational college instructor teaching

competencies, including their knowledge, skills, and attributes.

## Methods

### *Participants and Procedure*

The participants were drawn from 6,217 industrial instructors from 86 technical colleges under the OVEC, in the 2016 academic year (Information Technology and Vocational Manpower Center, 2015). The industrial instructors were from six departments, which included: (1) Mechanical Power Technology, (2) Machine Tool Technology, (3) Electrical Power, (4) Electronics Technology, (5) Metal Technology, and (6) Construction Technology. The colleges were located in five different regions of Thailand. This included 24 colleges in the Bangkok metro area and provinces just east of Bangkok, 21 colleges in the central region, 23 colleges in the northeast, and 18 colleges in the south. After a process of a cluster and stratified random sampling, 938 industrial instructors from 37 technical colleges were selected. Borrowing statistical sampling guidance from Hair, Black, Babin, and Anderson (2010), a sampling ratio of 20:1 was adopted. As the study contained 22 observable variables, suitable samples were suggested to be at least 440. However, in this study, the samples were selected from 938 instructors in total in order to gather as much information for the model's hypotheses testing.

### *Research Instrument*

The instrument used was a questionnaire which was divided into two parts. Part 1 included a checklist questionnaire of eight items about personal and general information. Part 2 included 98 main elements and sub-element items about industrial instructor teaching competency in the 21<sup>st</sup> century, which used a 5-point Likert type agreement scale (Likert, 1967). The 98-item questionnaire was verified for its content validity by seven specialists, with all items having an index of item objective congruence (IOC) between 0.80–1.00. Furthermore, to help with questionnaire content validity, a tryout using 30 OVEC industrial instructors was conducted. The findings from this trial indicated that the questionnaire's reliability had a Cronbach's Alpha coefficient ( $\alpha$ ) of 0.98.

### *Data Collection*

First, invitation letters were sent out to 30 qualified specialists to verify the questionnaire's contents (try-out process). After receiving letters of acceptance, we confirmed acceptance of the qualified specialists via telephone and informed them of the research objectives and related details. Then, an appointment was arranged for each person to provide the questionnaire directly. However, if this was not feasible, the questionnaire could be returned in person (by calling the authors for it to be picked up) or by the post office.

From the initial 30-individual try-out, the questionnaire was reviewed and items adjusted. Next, to collect data from the 938 participants, invitation letters were sent to the heads of departments in selected colleges. Appointments were made when possible to meet the survey participant in person to inform them of the research area and questionnaire details when possible. One thousand questionnaires were passed to participants who were willing to answer them. We asked each college for cooperation in order to collect questionnaires from participants within three weeks. After three weeks, we followed up via telephone. The time for data collection was set from July 2016 to October 2016, with us receiving most of the questionnaires within the timeframe. Last, we selected 938 completed and audited questionnaires for further analysis.

### *Data Analysis*

Descriptive statistics were used to analyze the questionnaire's content validity. As suggested by qualified specialists, we used the Statistical Package for the Social Sciences (SPSS) version 21 software program. The second order confirmatory factor analysis (2<sup>nd</sup> order CFA) of the vocational college instructor teaching competency was done using the AMOS module.

## Results

The analysis of the 2<sup>nd</sup> order CFA of the teaching competency of industrial instructors found that  $\chi^2 = 93.931$ ,  $df = 77$ , and  $p = .118$ , which was not statistically significantly different. Also, it found that root mean square error of

approximation (RMSEA=.014) and root mean square residual (RMR=.003) also approached 0, indicating good model fit (MacCallum, Browne, & Sugawara, 1996). Furthermore, the goodness of fit index (GFI=.991), adjusted goodness of fit index (AGFI=.971), and the comparative fit index (CFI=.99) were shown to have appropriate fit. This is supported by Byrne (1998) which indicated that CFI values should be  $\geq 0.93$ . An AGFI and GFI should also be at least .90, with close to 1 indicating a good model fit (Jöreskog & Sörbom, 2015). Further results indicated that chi-square  $\chi^2/df=1.194$ , which indicates a good model fit, as it was below 2. These results are also consistent with recommendations from Diamantopoulos and Siguaw (2000), in which model fit could be verified if all t-values were greater than 1.96, the construct reliability (CR) was greater than 0.60, and the average variance extracted (AVE) was higher than 0.50. Kline (2015) also spoke strongly about which indices to include and advocates the use of the chi-square test, the RMSEA, the CFI, and the SRMR.

### *Knowledge*

From the findings, the CFA showed that elements of knowledge [KN] were positive, with sub-elements scores from 0.482–0.865, and was significant at 0.05. Classroom management (KN7=0.865) was found to have the greatest importance, followed by measurement and evaluation (KN10=0.808), research for development (KN8=0.801), technology (KN9=0.779), curriculum and learning management (KN6=0.762), being a professional teacher (KN1=0.680), psychology for teachers (KN5=0.628), self-improvement (KN2=0.602), communication (KN4=0.589), and professional knowledge (KN3=0.482). Also,  $R^2$  was from 0.232 to 0.749.

### *Skill*

Skill [SK] had sub-element scores of between 0.669 to 0.880, while t was positive and significant at 0.05. Measurement and evaluation skill was found to have the greatest importance (SK8=0.880), followed by classroom management skill (SK5=0.813), curriculum and learning management

skill (SK4=0.812), psychology for teacher skill (SK9=0.790), communication (SK3=0.786), research for development skill (SK6=0.739), technology skill (SK7=0.678), and self-improvement skill (SK1=0.669). Also,  $R^2$  was from 0.448 to 0.774.

### *Attributes*

Attributes [AT] had sub-element scores from 0.486 to 0.888, which were positive and significant at 0.05. Attitude towards the teaching profession (AT1=0.888) was found to have the greatest importance, followed by personality (AT2=0.724) and ethics of the teaching profession (AT3=0.486). Also,  $R^2$  was from 0.236 to 0.788.

In conclusion, the 2<sup>nd</sup> order CFA showed that the three main elements of knowledge, skill, and attributes were positive and had significance at 0.05 (Table 1). The scores were between 0.919 to 0.976, in which the highest was skill (0.976), attributes (0.949), and knowledge (0.919), respectively.

## **Discussion**

From the analysis, the 2<sup>nd</sup> order CFA of the vocational college instructor teaching competency was positive. The scores were slightly different in the three elements evaluated, with the highest being skill (SK = .976), followed by the teacher's attributes (AT = .949), and then their knowledge (KN = .919). This is consistent with McClelland (1973) and his work concerning the value of competency over intelligence, in which knowledge consisted of training, seminars, and workshops; skills consisted of expertise; and proficiency and attributes consisted of attitude, value, identity, and personality. Parry (1977) added that competency included a cluster of abilities, including knowledge, skills, and attributes of individuals which can be acquired through training. Also, Gagné (1985) offered the categories of cognition as a scheme for the classification of learned abilities, such as intellectual skills, cognitive strategies, verbal information, motor skills, and attitudes.

### *Skill*

From the study's results, SK was determined to play the most important role (SK = .976) in a Thai

**Table 1**  
*Analysis of the CFAs of Thai Vocational College Instructor Teaching Competency*

Main Element	Variable	Factor Score			
		$b_{sc}$	S.E.	t (C.R.)	Reliability ( $R^2$ )
<b>Analysis of the 1<sup>st</sup> Order CFA</b>					
<b>Knowledge (KN)</b>	KN1	.680	<- ->	<- ->	.462
	KN2	.602	.043	21.007	.362
	KN3	.482	.050	15.159	.232
	KN4	.589	.047	18.257	.347
	KN5	.628	.050	19.238	.394
	KN6	.762	.061	20.154	.580
	KN7	.865	.055	23.671	.749
	KN8	.801	.072	21.497	.642
	KN9	.779	.073	20.612	.608
	KN10	.808	.061	22.200	.653
<b>Skill (SK)</b>	SK1	.669	<- ->	<- ->	.448
	SK2	.678	.042	18.709	.460
	SK3	.786	.048	20.098	.619
	SK4	.812	.045	20.874	.660
	SK5	.813	.037	23.135	.660
	SK6	.786	.046	24.553	.618
	SK7	.739	.046	22.749	.545
	SK8	.880	.046	23.123	.774
	SK9	.790	.050	21.317	.624
<b>Attributes (AT)</b>	AT1	.888	<- ->	<- ->	.788
	AT2	.724	.033	25.164	.524
	AT3	.486	.033	15.904	.236
<b>Analysis of the 2<sup>nd</sup> Order CFA</b>					
	KN	.919	<- ->	<- ->	.845
	SK	.976	.089	17.553	.952
	AT	.949	.068	21.548	.900

*Note.* \* $p < 0.05$ , bsc=standardized loading, <- ->=fix parameter, not report S.E. and t. Chi-square=91.931, df=77,  $p=.118$ ,  $\chi^2/df= 1.194$ , RMSEA=.014, RMR .003, GFI=.991, AGFI=.971, CFI=.999.

vocational teacher’s competency. This is consistent with other studies in which a teacher’s SK is considered to be a necessary competency, as teachers are expected to acquire skills such as teaching, planning, teamwork, classroom management, technological self-study, and life-long learning (Office of the National Education Commission, 2002; Thailand’s Voluntary National Review, 2017).

The study of Tampang and Wonggo (2018) also agreed that professional teaching standards of vocational teachers should strengthen their areas of expertise and their duties as a teacher. Attributes were placed second, which consisted of sub-elements including teaching profession attitudes, personality, and teaching profession ethics.

This is consistent with Nigerian vocational education research by Audu, Igwe, and Onoh (2013). From the results, it was indicated that vocational education plays an essential role in equipping labor with employment skills for the 21st century. However, infrastructure, quality teachers, and workshop facilities were seriously lacking in meeting these goals.

*Attributes*

A teacher’s attributes (AT = .949) was evaluated to be second in importance. This is consistent with Hessong and Weeks (1990), who pointed out 13 characteristics of a good teacher. These included: (1) being knowledgeable, (2) being humorous, (3) being flexible, (4) being upbeat, (5) being honest, (6) being

clear and concise, (7) being open, (8) being patient, (9) being a role model, 10) being able to relate theory to practice, (11) being self-confident, (12) being diversified, and (13) being well groomed and having personal hygiene.

In a 21<sup>st</sup> century classroom, being knowledgeable translates into the instructor’s ability to access information through various devices. Therefore, the level of importance and need for Hessong and Weeks’ (1990) attributes might be different and debated. In general, in-depth content knowledge obtained through the Internet is recognized as being a key attribute. With information changing so rapidly, the tools and methods to accomplish this task have changed as well.

In previous years, knowing how information was stored and cataloged in a library was crucial. Today, knowing how to access an Internet broadband service provider over a smartphone which can gain access to Google is critical within a classroom. Numerous studies also suggest that by use of multimedia technology and learning management systems (LMS) software, such as Edmodo, Schoology, and Moodle, that classrooms can be “flipped,” and learning achievement outcomes increased (Pradubthong, Petsangri, & Pimdee, 2017). Once again, a teacher’s technology familiarity has become a key attribute in a 21<sup>st</sup>-century classroom (Leekitchwatana, Pimdee, & Moto, 2013; Phuapan, Viriyavejakul, & Pimdee, 2016).

**Table 2**  
*Goodness-of-Fit Index (GFI) of the CFA Analysis of Thai Vocational Education Teaching Competency*

<b>Index</b>	<b>Acceptance*</b>	<b>Score</b>	<b>Result</b>	<b>Conclusion</b>
1. $\chi^2$ -Sig (p)	> 0.05	0.118	Pass	Good
2. $\chi^2/df$	< 3	1.194	Pass	Good
3. GFI	> 0.90	0.991	Pass	Good
4. AGFI	> 0.90	0.971	Pass	Good
5. CFI	> 0.90	0.999	Pass	Good
6. RMR	< 0.05	0.003	Pass	Good
7. RMSEA	< 0.05	0.014	Pass	Good

Source. \*Kline (2015).

### *Knowledge*

Knowledge ranked as the least significant element in the analysis of a Thai vocational teacher's competency because it is now expected that industrial teachers or instructors need to improve themselves by keeping up with learning. Similarly, a study on the competency of teachers in Finland suggested that teachers should emphasize research-based learning, having self-improvement skills, and being able to consult students by doing research and teaching (Jakku-Sihvonen & Niemi, 2006).

Therefore, as a teacher, it is necessary to improve continuously and to be an expert in areas of teaching. More importantly, instructors are expected to apply technology to the teaching and learning process, and to be a facilitator, encouraging students to learn, plan, and build on their own. The learning environment should be suitably arranged for effective learning, be open for self-discovery, allow learning from real life situations, and allow students to engage in cooperative learning with peers, teachers, other institutions, and the community. Teachers or instructors in the 21<sup>st</sup> century must emphasize self-discovery.

### **Conclusion**

The study investigated how Thai vocational education teacher competency was affected by various factors. From the results of the study, skill was determined to play the greatest role, followed by attributes, and finally knowledge. The reasons for this order is based on an educator's expected technical competency in the use of information communications technology (ICT). This includes such things as learning management systems, social media platforms, smartphones, Internet broadband, search engine tools, and classroom software. Today, a teacher needs to find and use resources outside the library and classroom if they are to be effective in a highly technological world. Teachers must also pass to students the skills necessary to thrive in a 21<sup>st</sup> century environment, which includes the ability for their understanding and use of these skills after they have left the classroom (lifelong learning).

There also needs to be support from school administrators and staff. This includes financial and

moral support. All too often, teachers are at odds with school administrators when new concepts outside their experience and understanding are introduced. Technology is something which must be embraced and used to its fullest, if educators want to produce a new generation of digitally savvy, knowledge workers for Thailand 4.0 and the 10 identified "S-Curve" industries critical for Thailand's economic future.

Today, educators and administrators must provide quality, demand-driven TVET, and skills development, both in and out of school. Consequently, core skills are assuming increasing importance and significance in the TVET and skills sectors, with UNESCO identifying the following factors as conducive to an Asian educator's success (Brewer & Comyn, 2015):

- curriculum goals and standards must be set and appropriate;
- teacher competencies must be developed which address the delivery and assessment of core skills;
- shaping school practices:
- supporting innovation;
- linking implementation with school development;
- leadership; and
- giving appropriate feedback through assessment and evaluation.

Furthermore, borrowing from the lessons learned in other countries such as Germany, policy-makers, and government leaders need to create incentives for employers to provide work-based experience and professional development opportunities for both teachers and students, so they are aware of the latest skills, industry requirements, and technologies.

### **Conflict of interest**

None.

### **Ethical clearance**

The study was approved by the institution.

## References

- Association for Career and Technical Education. (2010). *Up to the challenge: The role of career and technical education and 21st-century skills in college and career readiness*. Alexandria, VA: National Association of State Directors of Career Technical Education Consortium and Partnership for 21st Century Skills. Retrieved from <https://tinyurl.com/ybds3u0q>
- Audu, R., Igwe, C. O., & Onoh, C. E. C. (2013). Human capital development in technical vocational education (TVE) for sustainable national development. *Journal of Education and Practice, 4*(7), 100–107. Retrieved from <https://tinyurl.com/y82p6p6r>
- Baron, A., Clake, R., Turner, P., & Pass, S. (2010). *Workforce planning: Right people, right time, right skills*. CIPD. Retrieved from <https://tinyurl.com/zhvmyuu>
- Brewer, L., & Comyn, P. (2015). *Integrating core work skills into TVET systems: Six country case studies*. International Labour Organization. Retrieved from <https://tinyurl.com/ya6pdsb6>
- Britland, M. (2013, June 19). What is the future of technology in education? *The Guardian*. Retrieved from <https://tinyurl.com/ybh4jm7v>
- Byrne, B. M. (1998). *Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Chonsook, D. (2016, April 18). ขับเคลื่อนการศึกษาไทยอย่างไรจึงถูกใจประชาชน โดย ดร.ดำรงดี ชลสุข [How to drive education to respond to people's need]. Matichon Online. Retrieved from <https://tinyurl.com/ybs5rzwa>
- Diamantopoulos, A., & Sigauw, A. D. (2000). *Introducing LISREL: A guide for the uninitiated*. London, UK: Sage Publications.
- Gagné, R. M. (1985). *The conditions of learning* (4th ed.). New York, NY: Holt, Rinehart, and Winston.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). New Jersey: Pearson Education, Inc.
- Hessong, R. F., & Weeks, T. H. (1990). *Introduction to the foundations of education* (2nd ed.). New York, NY: Pearson.
- Hoonthong, P. (2015). *Study on the current status and challenges encountered in preparing Thai accounting professionals for ASEAN in the vocational education stream*. (Unpublished master's thesis). Chulalongkorn University, Bangkok, Thailand. Retrieved from <http://cuir.car.chula.ac.th/handle/123456789/50128>
- Information Technology and Vocational Manpower Center. (2015). *Institutions under OVEC*. Bangkok: OVEC. Retrieved from <https://tinyurl.com/yddqlwh9>
- Jakku-Sihvonen, R., & Niemi, H. (Eds.). (2006). *Research-based teacher education in Finland-Reflections by Finnish teacher educators*. Finnish Educational Research Association. Retrieved from <https://tinyurl.com/y9jazbvy>
- Jones, C., & Pimdee, P. (2017). Innovative ideas: Thailand 4.0 and the fourth industrial revolution. *Asian International Journal of Social Sciences, 17*(1), 4–35. doi: 10.29139/aijss.20170101
- Jöreskog, K. G., & Sörbom, D. (2015). *LISREL 9.20 for Windows* [Computer software]. Skokie, IL: Scientific Software International, Inc.
- Kabita, D. N., & Ji, L. (2017). *The why what and how of competency-based curriculum reforms: The Kenyan experience*. UNESCO. Retrieved from <https://tinyurl.com/y9d5rorq>
- Kline, R. B. (2015). *Principles and practice of structural equation modeling* (4th ed.). New York, NY: The Guilford Press.
- Likert, R. (1967). *The human organization: Its management and values*. New York, NY: McGraw-Hill Book.
- Leekitchwatana, P., Pimdee, P., & Moto, S. (2013). Factor analysis of competency of computer teacher at vocational certificate level. *Creative Education, 4*(5), 348–356. Retrieved from <http://file.scirp.org/Html/31383.html>
- MacCallum, R. C., Browne, M. W., & Sugawara, H., M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*(2), 130–149.
- McClelland, D. (1973). Testing for competence rather than for intelligence. *American Psychologist, 28*(1), 1–14. <https://doi.org/10.1037/h0034092>
- Ministry of Education. (2016, February 29). Merging public and private vocational colleges in Thailand. Retrieved from <https://tinyurl.com/y6v78gvx>
- Office of the National Education Commission. (2002). *National Education Act B.E. 2542 (1999) and Amendments (Second National Education Act B.E. 2545 (2002))*. Office of the Prime Minister. Retrieved from <https://tinyurl.com/ydf7xj8d>
- Office of the National Economic and Social Development Board. (2016). *The twelfth national economic and social development plan (2017–2021)*. Bangkok, Thailand: Office of the Prime Minister. Retrieved from <https://tinyurl.com/y8mqn0cg>
- P21. (2007). *The intellectual and policy foundations of the 21st century skills framework*. Washington DC: Partnership for 21st Century Skills. Retrieved from <https://tinyurl.com/y7cfdvyk>
- Parry, S. B. (1997). *Evaluating the impact of training: A collection of tools and techniques*. Alexandria, VA: American Society for Training & Development.
- Phuapan, P., Viriyavejakul, C., & Pimdee, P. (2016). An analysis of digital literacy skills among Thai university seniors. *International Journal of Emerging Technologies in Learning, 11*(3). doi: 10.3991/ijet.v11i03.5301

- Pradubthong, N., Petsangsri, S., & Pimdee, P. (2017). Flipping the classroom: Dilemmas and challenges for a 21st century classroom. *Asian International Journal of Social Sciences*, 17(4), 75–94. doi: 10.29139/aijss.20170404
- Pumim, A., Srinuan, C., & Panjakajornsak, V. (2017). Mobile phone customer loyalty in Thailand: A path analysis case study. *Asia-Pacific Social Science Review*, 16(3), 65–82. Retrieved from <https://ejournals.ph/article.php?id=11332>
- Reeve, E. M. (2016). 21st-century skills needed by students in technical and vocational education and training (TVET). *Asian International Journal of Social Sciences*, 16(4), 65–82. doi:10.29139/aijss.20160404
- Scott, C. L. (2015). *The future of learning 2: What kind of learning for the 21st century?* United Nations Educational, Scientific and Cultural Organization (UNESCO). Retrieved from <https://tinyurl.com/zhvmyuu>
- Sermirikarnjana, P., Kiddee, K., & Papat, P. (2017). An integrated science process skills needs assessment analysis for Thai vocational students and teachers. *Asia-Pacific Forum on Science Learning and Teaching*, 18(2), Article 3. Retrieved from <https://tinyurl.com/yamlncjm>
- Tampang, B. L. L., & Wonggo, D. (2018). Teacher professionalism in technical and vocational education. *IOP Conference Series: Materials Science and Engineering*. Retrieved from <https://tinyurl.com/y8zc7q5n>
- Thailand's Voluntary National Review. (2017, June). *Thailand's voluntary national review on the implementation of the 2030 agenda for sustainable development*. Retrieved from <https://tinyurl.com/y72rokzy>
- Tielman, K., den Brok, P., Bolhuis, S., & Vallejo, B. (2011). Collaborative learning in multicultural classrooms: A case study of Dutch senior secondary vocational education. *Journal of Vocational Education and Training*, 64(1). <https://doi.org/10.1080/13636820.2011.622448>
- Tongliemnak, P., Tharmmapornphilas, R., & Pumsiri, J. (2016). *Thailand's Technical and Vocational Education Training (TVET), Education Finance and Dual Vocational Education*. Paper presented at the 2<sup>nd</sup> ASEAN+3 Forum on Dual Training and Skills Financing. May 23-25.
- UNESCO. (2011). *UNESCO national education support strategy (UNESS): Thailand*. Thailand: UNESCO Office Bangkok and Regional Bureau for Education in Asia and the Pacific.
- West, D. W., & Bleiberg, J. (2013, May 7). Five ways teachers can use technology to help students. *Brookings*. Retrieved from <https://tinyurl.com/yahjs06r>