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Digital Pedagogy Policy in Technical and Vocational Education and Training (TVET) in Malaysia: Fuzzy Delphi Approach

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Abstract: Digital platforms are one of the technology adoption that is beginning to be used in most vocational colleges today. Services provided through digital platforms are an alternative to conventional methods. However, the use of digital platforms nowadays, among users consisting of vocational college students in Malaysia is still at a less than satisfactory level. Previous studies also focused a lot on the use and acceptance of technology platforms among users in schools only but not in vocational colleges (VC). The aim of the research is to determine the experts' consensus on the objective of the digital pedagogy policy for Technical Education and Vocational Training (TVET) students especially in vocational colleges which is currently under development. Vocational colleges is one of the Technical Education and Vocational Training (TVET) institutions in Malaysia that offers certificate level and skill diploma education to high school students. Therefore, it is important to identify the policy that will be used. The Fuzzy Delphi Technique (FDT) was used in this research. Ten experts were chosen by utilizing the purposive sampling method. Analysis of the data was using the Triangular Fuzzy Number and Defuzzification process. The findings showed 100% consensus was achieved by the experts for objectives 1 and 3, and 90% consensus was achieved by the experts for objective 2. All of the experts agreed on the elements in the objectives of the digital pedagogy policy for TVET students. Further development of this policy hopefully will help the teachers in improving their knowledge of digital pedagogy and increase their competency pedagogy in order to produce skills oriented workforce among TVET students in Malaysia. Therefore, the results of this study are expected to be used to strengthen the development of e-learning models in the future to help students and educators to use digital platforms in vocational colleges in particular.

Keywords: Pedagogy, digital pedagogy, TVET pedagogy, digital pedagogy policy, Fuzzy Delphi Technique (FDT)

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1. Introduction

Pedagogy is defined as an art and science of teaching that includes principles, strategies, methods, techniques, and various considerations in ensuring successful teaching (Cruickhank et al., 1995), a medium to connect what the teacher wants students to learn with the actual learning that students will acquire (Slavin, 1997), and teaching methods that involve knowledge and skills related to a knowledge discipline (Sylva et al., 2011; Siraj-Blatchford, et al., 2003). Pedagogy is a very important field of knowledge in education which includes three main aspects namely preparation, delivery and evaluation (Sulaiman Ngah Razali, 1997). It is a broad and deep knowledge about the teaching and learning process, classroom management, school organization, school curriculum, teaching behaviour, teacher-student interaction and so on.

Digital pedagogy refers to professionalism competence which includes the ability to master pedagogy effectively by teachers. Digital learning requires an appropriate pedagogical approach that requires teachers to integrate digital competence into their practice (Aslan & Zhu, 2016; Tammaro & D'Alessio, 2016). Education reform nowadays emphasizes the need to increase the digital use of technology for learning and assessing those skills (Ahonen & Kankaanranta, 2015; Göçen et al., 2020). According to Faber et al., (2017), digital technology serves different educational purposes and offers various benefits compared to traditional learning tools such as effective tools to promote achievement and collaborative learning (Laakso et al., 2018; Kurvinen et al., 2018; Kurvinen et al., 2020), and a useful assessment tool to track student learning progress and improve teacher teaching (Faber et al., 2017; Kurvinen et al., 2016; Laakso et al., 2018).

Malaysia Education Blueprint 2013-2025 through the 6th shift of Educational Transformation (ICT in Education) has been implemented to increase the outcome and interest of students by a new learning approach based on ICT which can be utilized effectively. In order to provide students with the knowledge and skills to learn in the digital world, the government has equipped 10, 000 schools throughout Malaysia including KV of Vocational Colleges with internet access and e-learning platforms such as 1 BestariNet and Virtual Learning Environment (VLE FROG), provides training on teachers to apply ICT in teaching and facilitation, increases ICT equipment with a ratio of 10 students and one computer, pioneers learning delivery methods using ICT such as independent and distance learning, and provides a host of e-learning video libraries through EduWebTV (Ministry of Education Malaysia, 2013).

2. Literature Review

2.1 TVET Pedagogy

World Bank and UNESCO-UNEVOC have found that vocational teachers in developing countries especially in the Southeast Asian region often do not meet the demands of the world's work due to the lack of effective knowledge transfer pedagogical skills (Johari et al., 2014). Derek Cheung (2001) and Zohar et al., (2001) mentioned that many attempts in educational change have failed because the teachers are unable to master the content of the teaching subjects, teaching strategies in the classroom, and skills in using technology tools. Previous studies showed that TVET pedagogy is still at a low level, does not meet the needs of the industry, and requires the application of knowledge and skills in teaching and learning (Majumdar, 2009; Lubis, 2010). Therefore, most of the students' learning becomes passive and does not help in improving their professionalism competency (Kurnia et al., 2013). Gerds (2008) stated that TVET pedagogy needs to be change into technological element approach because its application in teaching will attract students' interest and provide a meaningful impact for them. The elements of knowledge and latest learning strategies in TVET pedagogy can produce graduates to meet the needs of the industry (McGrath, 2006; Lubis, 2010). This is in line with the Malaysia Education Blueprint 2013-2025 which encourages the use of technology and mixed learning elements in teaching (Ministry of Education Malaysia, 2013). TVET division has drafted the standard curriculum for KV of Vocational Colleges as an effort to respond to MoE's desire to provide skilled labor in accommodating the rapid progress of country (Ag Damit & Omar, 2019). It is designed based on the optimal use of the latest technology in teaching and learning (Ministry of Education Malaysia, 2017a) and the evolution of Industrial Revolution 4.0 become a benchmark in its development.

In addition, new learning methods based on technology such as blended learning and flipped classrooms have been introduced in the curriculum (Ministry of Education Malaysia, 2013). In this 21st century, instructors and teachers need to be more active as facilitators in teaching and learning process in order to optimally increase students' potential (Ministry of Education Malaysia, 2017b). Technology can improve pedagogical approach techniques, integrate curriculum in teaching, affect student achievement and increase student confidence in using technology in learning (McCoy, 1998). However, ICT integration will not be successful if teachers hard to connect technology with content and pedagogy (Mishra & Koehler, 2003), and difficult to find pedagogy that is suitable to use with technology (Ilomäki, 2008).

According to Mat Som and Saleh (2013), the most popular pedagogical practices in the welding curriculum are demonstrations and lectures with mean values of 3.05 and 3.22 respectively which clearly shows that the TVET teachers are still dominated by traditional methods. Therefore, the Department of Polytechnic Studies has determined that 50% of the courses organized by public higher learning institutions must take place online by using a blended learning approach starting from 2014 (Salleh & Abdul Manaf, 2017). Pedagogy in Malaysian polytechnics needs to apply the elements of industry requirements in teaching and learning to fulfil the desire to achieve skilled and knowledgeable workers to meet the needs of the future (Ministry of Education Malaysia, 2013; Ridzwan Che Rus, Ruhizan M Yasin, & Mohammad Sattar Rasul, 2014).

The blended learning concept should focus on 21st-century pedagogy that combines traditional and online learning during the teaching and learning process (Mohd Azli Yeop et al., 2016) with the aim of maximum understanding of a principle, theory and knowledge. It is a student-centred approach in which students can control their own learning rate and use various online technologies that include the aspects of collaborative learning, critical thinking, creative thinking, and communication that includes the use of ICT, assessment, higher-order thinking skills, and project-based learning (Ismail & Othman, 2021). The debate on 21st pedagogy is often linked to digital pedagogy (Bauder, & Simmons, 2017; Maor, 2017) as information and communication technology are considered as the main components that should be mastered in the skills (Niemi, & Multisilta, 2016; van Laar et al., 2017).

Loveless et al., (2001) stated that teachers should know about technology as well as appreciate the aspects of technology and pedagogy that have changed due to the integration of technology in teaching. Embi (2010) asserted that the use of online forums in teaching is very practical and reasonable, and becomes a norm in today's education. The rapid revolution makes technology become a medium to deliver information and communication, especially in teaching and learning in the cyber era (Livingstone, 2012). However, previous studies show that the success of any initiative related to the integration of ICT in education depends on the acceptance and involvement of teachers (Gibson et al., 2014; Teo, 2011; Paraskeva et al., 2008).

The teachers' acceptance of ICT integration is influenced by several personal, technical and environmental factors (Kim et al., 2013; Teo & Zhou, 2017; Wang et al., 2017). If technology is only used to replace existing teaching methods without bringing pedagogical changes, it will not have a positive effect on students (Kim et al., 2013). Close attention must be given to the exposure of new technology and the latest pedagogy that is compatible with technological sophistication (Luna, 2015), as meaningful and authentic technology integration to support 21st-century pedagogy cannot rely entirely on technology-related factors (Kimmons et al., 2015; Tondeur et al., 2017). Instead, the focus needs to be on teachers' beliefs and skills in making decisions about the best method of integrating ICT in the classroom (Deng et al., 2014; Inan & Lowther, 2010).

Continuous improvement of pedagogical competence is necessary to increase teacher teaching competency, especially in the TVET field. Therefore, this research was focusing on developing a digital pedagogy policy for TVET as digital pedagogy had become a part of the education system nowadays. A systematic policy of digital pedagogy hopefully can help and support the teachers in their teaching and learning process to able in implementing effective knowledge transfer. The development of the latest digital pedagogy policy can become a pillar in national TVET policy, as well as being recognized as an important element in the successful implementation of teaching and learning whether it is conventional or online.

3. Methodology

3.1 Research Design

The Fuzzy Delphi Technique (FDT) was used in this research. The selection to use this technique was taken in the context of the research's objective to determine professional agreement on the factors involved in designing policy development. Hasim et al., (2023) claim that FDT can be used to reach an agreement among experts on a subject. The FDT is preferred over the Delphi technique because it manages questionnaires more efficiently at a lower cost. It also enables specialists to regularly express their opinions (Ciptono et al., 2019).

3.2 Sample

In order to achieve great consistency, the Fuzzy Delphi investigations require a minimum sample size of 10 experts among specialists (Adler & Ziglio, 1996; Jones & Twiss, 1978). Consequently, 10 experts were chosen for this research by utilizing the purposive sampling method. They were made up of experts in technical and vocational education, educational technology and curriculum development. The experts had at least a bachelor's degree as an academic qualification and a minimum of five years of field experience. Berliner (2004) stated that an individual is considered skilled in a field if he has had more than five years of experience in that field, while Gambatese et al., (2008) stated that experts must have high academic qualifications.

3.3 Data Collection

To implement the FDT, the researcher first needs to determine and arrange the items produced through the findings of Phase I and Phase II in a neat form that can be mastered by the panel of experts. After that, a group of experts who agreed to contribute their expertise in expressing ideas, criticizing and improving the content of the items were determined by the researcher. The experts were contacted to confirm their agreement to be an expert and attend the workshop that had been set up. Once all of the experts had expressed their agreement, formal invitation letters were sent by post, electronic mail and hand-delivered. A workshop was held for one day and the experts were given a set of questionnaires. In the first slot, the experts were asked to choose their level of agreement for each item in the questionnaire as Strongly Agree, Agree, Less Agree, Disagree and Strongly Disagree (5-point Likert scale). For the second slot, the experts were asked to express their opinions on each item in the questionnaire.

3.4 Data Analysis

The data obtained from 5 points Likert Scale was translated into the form of Fuzzy number data and analyzed by using Microsoft Excel software. This data analysis technique is known as Fuzzy Delphi Technique (FDT) or Fuzzy Delphi Method (FDM). There are two important aspects in FDT namely Triangular Fuzzy Number and Defuzzification process. A triangular Fuzzy Number is arranged with values m1, m2 and m3 and usually, it is shown in the form (m1, m2, m3). The m1 represents minimum value, m2 represents reasonable value, and m3 represents maximum value. Triangular Fuzzy Number is used to produce a Fuzzy scale (similar to the Likert scale) for the purpose of translating linguistic variables into Fuzzy (digital/ binary numbers). The numbers of the agreement stage or level for the Fuzzy scale are in odd numbers. The higher the Fuzzy scale, the more accurate the data obtained.

In this research, the process of collecting and analysing FDT was conducted through two stages. The first stage was done during the workshop of the experts. In the workshop, every expert was given items with 5 point Likert scale and a blank space for description or comments and expert recommendations. In the second stage, data obtained from the Likert scale was analysed by using the Excel programme for better tabling. All of the data were converted into the form of triangular Fuzzy numbers. Then, the data were tabulated for Fuzzy value (n1, n2, n3) and Fuzzy average value (m1, m2, m3) to obtain threshold value, percentage of expert's consensus, defuzzification and ranking item. In order to get experts' consensus for each item, the threshold value should not exceed 0.2.

The percentage of the expert's consensus somehow needs to exceed 75% value, while the defuzzification value for each item must exceed the α-cut value = 0.5. The d value was the threshold value. If the d value ≤ 0.2, it means that all of the experts had achieved consensus towards the related items. But if otherwise happened, a second round must be made to see whether the item is needed or not (Chen, 2000, Cheng & Lin, 2002). FDT also involved the process of determining the consensus of group experts whether exceeds or is equivalent to 75% of the overall construct or for each item. Every item was assumed as achieving the expert's consensus if the percentage of the expert's consensus for the related items were equivalent to or exceeded 75% (Chu & Hwang, 2008, Murray & Hammons, 1995). Proses of defuzzification were also done in analysing the research data of FDT. It is a process to determine the rank or priority for each item or to determine the rank for each variable and sub-variable.

4. Findings

4.1 Experts' Demographic Information

Table 1 showed the experts' demographic information. The majority of the experts were male and 50% of them had more than 15 years' of experience in the field of TVET. They were experts in curriculum developer of technical and vocational education, teachers in TVET Pedagogy and teachers in Educational Technology.

Table 1 - Experts' demographic

No.	Statement	Demographic	Percentage (N)
1	Gender	Male	70.0% (7)
		Female	30.0% (3)
2	Experience Duration in TVET	5-9 years	20.0% (2)
		10- 14 years	30.0% (3)
		15 years and above	50.0% (5)
3	Expertise	Curriculum developer of TVET	40.0% (4)
		Lecturer (TVET Pedagogy)	30.0% (3)
		Lecturer (Educational Technology)	30.0% (3)

4.2 Analysis of Expert Consensus on The Objectives of Digital Pedagogy Policy for TVET Students

Table 2 showed the three objectives of this research and FDT was used to analyse the expert consensus on them. The expert consensus achieved 100% consensus for objective 1 with d value =0.049, "Empowering students towards a creative and innovative digital content delivery system", and objective 3 with d value = 0.179, "Encouraging students in vocational colleges to use technology to solve problems". Meanwhile, objective 2 only achieved 90% consensus with d value = 0.141, "Inculcating students in positive, safe, legal and ethical behaviour when using technology including during online social interactions or while using devices."

Table 2 - Experts' consensus for the objectives of digital pedagogy policy for TVET students

No.	Item/ Element	Triangular Fuzzy Numbers Condition		Fuzzy Evaluation Process Condition				Experts Consensus
		Threshold Value, d	Percentage of Experts Consensus, %	m1	m2	m3	Fuzzy Score (A)	
1	Empowering students towards a creative and innovative digital content delivery system	0.049	100.0%	0.860	0.980	1.000	0.947	Accept
2	Inculcating students in positive, safe, legal and ethical behavior when using technology including during online social interactions or while using devices	0.141	90.0%	0.780	0.920	0.970	0.890	Accept
3	Encouraging students in vocational colleges to use technology to solve problems	0.179	100.0%	0.720	0.870	0.960	0.850	Accept

Condition:
Triangular Fuzzy Numbers
1) Threshold Value (d) ≤ 0.2
2) Percentage of Experts Consensus > 75%
Defuzzification Process
3) Fuzzy Score (A) ≥ α – cut value = 0.5

Table 3 showed the d value of expert's consensus according to their expertise which were higher and approaching 100%.

Table 3 - Experts consensus according to their expertise on the objectives of digital pedagogy policy for TVET students

EXPERTS	ELEMENT		
	1	2	3
Curriculum developer of TVET	0.031	0.110	0.171
Lecturer (TVET Pedagogy)	0.031	0.571	0.221
Lecturer (TVET Pedagogy)	0.122	0.059	0.221
Lecturer (Educational Technology)	0.031	0.110	0.051
Curriculum developer of TVET	0.031	0.110	0.171
Lecturer (TVET Pedagogy)	0.031	0.110	0.171
Lecturer (Educational Technology)	0.031	0.110	0.171
Curriculum developer of TVET	0.031	0.059	0.221
Curriculum developer of TVET	0.031	0.110	0.221

Lecturer (Educational Technology)	0.122	0.059	0.171
Threshold Value (d) for each item	0.149	0.141	0.179
Percentage of Experts Consensus (%)	10	9	10
Fuzzy Score Value (A)	100.0%	90.0%	100.0%

Condition:
Triangular Fuzzy Numbers
1) Threshold Value (d) ≤ 0.2
2) Percentage of Experts Consensus > 75%
Defuzzification Process
3) Fuzzy Score (A) ≥ α – cut value = 0.5

All of the experts achieved consensus on objectives 1 and 3. But, objective 2 only achieved 90% consensus among the experts. An expert of TVET pedagogy who was a lecturer involved in TVET teaching slightly agreed with objective 2. However, the overall construct had a threshold value (d) ≤ 0.2. According to Cheng and Lin (2002), if the average value and expert's evaluation were less than the threshold value, d= 0.2, the sub-construct had gained consensus from the experts.

5. Discussion

From the above findings, the researcher had identified that all of the elements were agreed upon by the experts. The elements were prioritized by the experts in each construct. The results showed that all of the elements need to be applied in designing the development of the digital pedagogy policy. According to Toktarova and Semenova (2020), digital pedagogy is a transformation of digital education to create a non-standard algorithm to solve the problems of traditional pedagogy by forming and developing innovative learning processes based on digital intelligence. It has four main components which are based on contents, environment, technology and based on competency. These findings were related to a previous study by Law, Lee, & Chow (2002), who stated that the characteristics of effective learning practices based on technologies in the 21st century, emphasize the characteristics of teachers' innovative pedagogical practices that will bring reform to the learning process. It has proven that students are more positive when they are able to learn information literacy skills by using the internet, is able to think critically, learn from various sources and are able to learn from their community through mutual respect for each other's ideas. The high level of technological literacy and wide access to information through the Internet among young students has formed a Generation Y that is active and innovative in the aspect of learning. At the same time, they also expect a quick response from the teaching staff in meeting their learning needs

The Malaysia Education Blueprint 2013-2025 has addressed the government's determination to achieve the vision of raising the level of the education system into the 21st century. Therefore, the teachers have to master student-centered teaching in order to implement the elements of communication, collaboration, critical thinking, creativity and values as well as ethics among the students. Teaching based on technology also no longer optional for teachers, but become a current need (McNierney, 2004) as technology has become one of the six pillars in the latest curriculum. That is why, all the teachers in TVET fields need to understand well skilfully in technologies especially in the pedagogy approach. Because TVET is an educational and training process that has a job orientation that emphasizes industry practices. It aims to produce a competent workforce in certain fields. The scope of TVET should be based on recognized occupational standards, with an emphasis on practical components, psychomotor skills and exposure to industry training.

As the young generation nowadays are growing up in a world filled with various digital technologies that shape their daily life (Vaataja & Ruokamo, 2021), teachers need to rethink suitable pedagogical practices to integrate digital technology into teaching practices (Sailin & Mahmor, 2018). Thus, a digital pedagogy policy is important as an indicator for the teachers to meet the current needs of the world of education, become more competitive and always be aware with the rapid development of technology. It can be used as a basis to guide an ability that can be observed, measured and evaluated (Frank et al., 2010). On the e-learning platform, the teachers should act as a facilitator and not instructors, and students are expected to be users active in seeking knowledge and not just products from the education system. This study is expected to guide KVand vocational institutions towards digital transformation.

Dangwal and Srivastava (2016) stated that a teacher needs to know the correct use of technology, pedagogy and specific subject materials to make daily teaching in the classroom efficient and effective. The emergence of innovative digital pedagogy is a phenomenon that promotes the combination of 21st-century professionals into a new era of education (Diaz-Noguera et al., 2022). It is an attempt to use technology to change teaching and learning in various ways including some axiomatic changes to traditional pedagogy and has more in common with the constructivist approach (Prakash, 2014).

Digital pedagogy can include web 2.0 technology for social networks with the use of blogs, wikis, i-phones and i-pads for learning that can promote relationships with the wider world (Kent & Holdway, 2009) as well as the use of digital technologies such as digital learning environments (Laakso et al., 2018; Umek et al., 2017), Moodle and

Blackboard (Alokluk, 2018; Umek et al., 2017) and web-based learning environments (Laakso et al., 2018). Past studies show that digital learning can encourage the active involvement of students in achieving learning outcomes (Pai & Tu, 2011), able to help improve and enhance student performance, especially for distance learning students (Zuraini et al., 2006), and increase student motivation and involvement in class (Hosseini et al., 2019).

6. Conclusion

A positive consensus had been achieved by all of the experts on the objective of digital pedagogy policy for TVET students. The development of digital pedagogy policy must have a clear and dynamic objective to achieve the national aspiration of increasing the country's competitiveness in a knowledge-based global era (Abdul Rahman et al., 2020). The development of Industry Revolution 4.0 had made the element of digitization a must-have for today's educators including in the field of TVET. The curriculum structure which is face-to-face teaching in practical and theoretical lectures is a big challenge that needs to be overcome to reduce the gap in the field of training and skills education in Malaysia.

The development of a suitable digital policy can be used as a guideline for teachers in the latest aspects of digitization pedagogy which is necessary especially when we had to face sudden situations. The teachers will have better preparation to ensure the teaching and learning process is implemented more effectively. The mastery of digitization pedagogy among teachers may increase the achievement of students in knowledge, skills and applications. Thus, teachers are required to develop teaching methods from conventional to new millennium pedagogy by making ICT the main catalyst to spread, and store information and help students to build new knowledge (Lechner & Boli, 2000).

In addition, cooperation between the Technical and Vocational Education Division and the Ministry of Education is essential in arranging courses, training or workshops on the pedagogy of 21st-century learning to the teachers, as well as providing complete ICT infrastructure in each KV of Vocational Colleges as suggested by Abdul Rahman and Mohammad Hussain (2020). Support from related parties certainly will help the teachers to improve their competence in teaching. Collaboration from other TVET institutions also can help in identifying suitable and appropriate courses in facilitating training related to effective digitization pedagogy. This will lead to an increase in the knowledge and skills required by teachers to ensure meaningful teaching and learning.

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References

Berliner, D. C. (2004). Describing the Behavior and Documenting the Accomplishments of Expert Teachers. *Bulletin of Science, Technology & Society*, 24(3), 200–212. https://doi.org/10.1177/0270467604265535

Chen, C. T. (2000). Extensions of the TOPSIS for Group Decision-Making under Fuzzy Environment. *Fuzzy Sets and Systems*, 114, 1-9.

Cheng, C. H., & Lin, Y. (2002). Evaluating the Best Main Battle Tank Using Fuzzy Decision Theory with Linguistic Criteria Evaluation. *European Journal of Operational Research*, 142, 74-86.

Chu, H. C., & Hwang, G. J. (2008). A Delphi-Based Approach to Developing Expert Systems with the Cooperation of Multiple Experts. *Expert Systems with Applications*, 34, 26-40.

Ciptono, A., Setiyono, S., Nurhidayati, F., & Vikaliana, R. (2019). Fuzzy Delphi method in education: A mapping. *Journal of Physics: Conference Series, 1360*, Article 12029. https://doi.org/10.1088/1742-6596/1360/1/012029

Cruickshank, D. R., Jenkins, D. B., & Metcalf, K. K. (1995). *The act of teaching*. New York: McGraw-Hill

Dangwal, K. L. & Srivastava, S. (2016). Digital Pedagogy in Teacher Education. International *Journal of Information Science and Computing*, 3(2): December 2016: p. 67-72. DOI: 10.5958/2454-9533.2016.00008.9

Deng, L., & Yu, D. (2014). Deep learning: methods and applications. *Foundations and Trends® in Signal Processing*, 7(3–4), 197-387

Derek Cheung. (2001). School-based assessment in public examinations: Identifying the concerns of teachers. *Educational Journal*, 29(2). The Chinese University of Hong Kong

Díaz-Noguera, M.D., Hervás-Gómez, C., De laCalle-Cabrera, A.M., López-Meneses, E. (2022). Autonomy, Motivation, and Digital Pedagogy Are Key Factors in the Perceptions of Spanish Higher-Education Students Toward Online Learning during the COVID-19 Pandemic. *Int. J. Environ. Res. Public Health* 2022, 19, 654.https://doi.org/10.3390/ijerph19020654

Embi, M. A. (2010). *Panduan Amalan Pengajaran & Pembelajaran Berkesan*. [A Guide to Effective Teaching & Learning Practices]. Pusat Pembangunan Akademik: Bangi

Frank, J. R., Snell, L. S., Cate, O. T., Holmboe, E. S., Carraccio, C., Swing, S. R., & Harris, K. A. (2010). Competency-based medical education: theory to practice. *Medical Teacher*, 32(8), 638-645

Gambatese, J.A., Behm, M., & Rajendran, S. (2008) Design's Role in Construction Accident Causality and Prevention: Perspectives from an Expert Panel, *Safety Science*, 46 (4), pp. 675-691.

Gerds, P. (2008). Shaping and evaluating vocational training offers. *Handbook of TVET Research*, 1

Gibson, P. A., Stringer, K., Cotten, S. R., Simoni, Z., O'neal, L. J., & Howell-Moroney, M. (2014). Changing teachers, changing students? The impact of a teacher-focused intervention on students' computer usage, attitudes, and anxiety. *Computers & Education*, 71, 165-174

Göçen, A., Eral, S. H., & Buçuk, M. H. (2020). Teacher perceptions of a 21st-century classroom. *International Journal of Contemporary Educational Research*, 7(1), 85–98. https://doi.org/10.33200/ijcer.638110

Hasim, M. A., Jabar, J., Sufian, A., Ibrahim, N. F., & Abdul Khalid, F. (2023). Employing fuzzy Delphi techniques to validate the components and contents of e-learning antecedents and usage behaviour towards e-learning performance. *European Journal of Educational Research*, 12(1), 467-480. https://doi.org/10.12973/eu-jer.12.1.467

Hosseini, H., Maxwell, H., & Mehrnaz Mostafapour (2019). Learning is child's play: game-based learning in computer science education. *ACM Transactions on Computing Education (TOCE)*, 19(3), 1-18

Ilomäki, L. (2008). *The effects of ICT on school: teachers' and students' perspectives*. Disertasi PhD. University of Turku, Finland

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development*, 58(2), 137-154

Ismail, M. Z. & Othman, M. K. (2021). Amalan Pedagogi Abad Ke-21 Dalam Kalangan Guru Pelatih Program Ijazah Sarjana Muda Perguruan (Pismp) Pendidikan Islam di Institut Pendidikan Guru Malaysia. [*21st Century Pedagogical Practices Among Teacher Trainees of the Bachelor of Teaching Degree Program (PISMP) in Islamic Education at the Malaysian Institute of Teacher Education*] *Jurnal Penyelidikan Dedikasi*, [S.l.], v. 13, p. 54-71, Feb. 2021. ISSN 2710-6810. Available at: https://myjms.mohe.gov.my/index.php/jd/article/view/12184

Johari, F. M., Othman, W., Ismail, H. N., & Isa, Z. (2014). Isu dan Cabaran Pelaksanaan Pendidikan Asas Vokasional (PAV) di Sekolah Menengah Harian, Malaysia. [*Issues and Challenges in the Implementation of Basic Vocational Education (PAV) in Secondary Schools, Malaysia]*. In *PDE Professional Development in Education Conference 2014*, 11-12 Juni 2014, Park Hotel Bandung

Jones, H., & Twiss, B. L. (1978). *Forecasting Technology for Planning Decisions*. New York: Macmillan

Kent, P., & Holdway, M. (2009). Interactive whiteboards, productive pedagogies and literacy teaching. *Literacy Learning: The Middle Years*, 17(1), 21-25

Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, 29, 76-85

Kimmons, R., Miller, B. G., Amador, J., Desjardins, C. D., & Hall, C. (2015). Technology integration coursework and finding meaning in pre-service teachers' reflective practice. *Educational Technology Research and Development*, 63(6), 809-829

Kurnia, D, Dittrich, J & Ilhamdaniah (2013). Occupational competence needs analysis as basis for TVET teacher curriculum development, RCP practice and working paper, no. 3, *Regional Cooperation Platform for Vocational Teacher Education in Asia*, *Shanghai*, viewed 22 Apr 2022, http://tvet-online.asia/wp-content/uploads/2020/03/PWP_vol-3_Kurnia_etal.pdf

Kurvinen, E., Dagienė, V., & Laakso, M.-J. (2018). The impact and effectiveness of technology-enhanced mathematics learning (pp. 344–356). *Lithuania: Proceedings of Constructionism*

Kurvinen, E., Kaila, E., Laakso, M.-J., & Salakoski, T. (2020). Long-term effects on technology enhanced learning: The use of weekly digital lessons in mathematics. *Informatics in Education*, 19(1), 51–75. https://doi.org/10.15388/infedu.2020.04

Kurvinen, E., Lokkila, E., Lindén, R., Kaila, E., Laakso, M., & Salakoski, T. (2016). Automatic assessment and immediate feedback in third-grade mathematics (pp. 89–94). Dublin: *Proceedings of Ireland international conference on education*

Laakso, M., Kaila, E., & Rajala, T. (2018). ViLLE – Collaborative education tool: Designing and utilizing an exercise-based learning environment. *Education and Information Technologies*, 23, 1655–1676. https:// doi.org/10.1007/s10639-017-9659-1

Law, N., Lee, Y., & Chow, A (2002). Pracice Characteristics That Lead to 21 st CeturyLearning Outcomes. *Journal of Computer Assisted Learning* (18), 415-426.

Livingstone, S. (2012). Critical Reflections on the Benefits of ICT in Education. *Oxford Review of Education*, 38(1), 9-24. Retrieved April 24, 2022, from https://www.learntechlib.org/p/68609/

Loveless, A., DeVoogd, G. L., & Bohlin, R. M. (2001). Something old, something new….: Is pedagogy affected by ICT? In A. Loveless, & V. Ellis (Eds.), *ICT, pedagogy and the curriculum: Subject to change* (page 63-83). London: Routledge Falmer

Lubis, S. (2010). Concept and implementation of vocational pedagogy in TVET Teacher Education. In *1stUPI International Conference on Technical and Vocational Education and Training. Bandung, Indonesia*

Luna, S. C. (2015). The Futures of Learning 3: what kind of pedagogies for the 21st century? *United Nations Educational, Scientific and Cultural Organization*

Majumdar, S. (2009). Major challenges in integrating sustainable development in TVET. In *International Experts meeting on reorienting TVET policy towards education for sustainable development* (pp. 1–15). Berlin, Germany

Maor, D. (2017). Using TPACK to develop digital pedagogues: a higher education experience. *Journal of Computers in Education*, 4(1), 71-86

Mat Som, Habib & Saleh, Baharudin (2013). Profil Amalan Guru Dalam Pelaksanaan Kurikulum Berasaskan Menengah Vokasional Kompetensi Di Sekolah. *[Profile of Teachers' Practices in the Implementation of Vocational Secondary Competency-Based Curriculum in Schools*]. *Jurnal Bitara*

McCoy, A. H. (1998). *Integration of technology into higher education teacher preparation programs.* Dissertation Abstracts International. 50(3): 793

McGrath, S. (2006). Skills for development: A new approach to international cooperation in skills development? *Journal of Vocational Education & Training*, 54(3), 413–430. doi: 10.1080/13636820200200207

McNierney, D. (2004). Case Study: One Teacher's Odyssey through Resistance and Fear, *TechTrends*, (48)5, pp. 64 – 68. http://dx.doi.org/10.1007/BF02763533

Ministry of Education Malaysia. (2013). *Pelan Pembangunan Pendidikan Malaysia (PPPM) 2013-2025*. [*Malaysian Education Development Plan (PPPM) 2013-2025*]. https://doi.org/10.1016/j.tate.2010.08.007

Ministry of Education Malaysia. (2017a). *Dasar Pendidikan Kebangsaan. In Bahagian Perancangan dan Penyelidikan Dasar Pendidikan. [National Education Policy. In Education Policy Planning and Research Division]*. (1st ed., Vol. 4). Retrieved from https://www.moe.gov.my/images/KPM/UKK/2019/03_Mac/Buku_Dpk_Jilid_Keempat.pdf

Ministry of Education Malaysia. (2017b). *Standard Kualiti Pendidikan Malaysia Gelombang 2.[Malaysian Education Quality Standard Wave 2*]. Retrieved from https://www.moe.gov.my/index.php/my/arkib/pemberitahuan/2018/4183-skpmg2-2018

Mishra, P., & Koehler, M.J. (2003). *Not "what" but "how": Becoming design-wise about educational technology.* In Zhao, Y. What should teachers know about technology? Perspectives and Practices (page 99-121). Greenwich, CT: Information Age Publishing

Mohd Azli Yeop, Noraini Mohamed Noh, & Kung Tech Wong (2016). Pembelajaran Teradun: Satu tinjauan literatur terhadap faktor- faktor penerimaan guru melalui model-model penerimaan. [*Blended Learning: A literature review on teacher acceptance factors through acceptance models*]. *Journal of Research, Policy & Practice of Teachers & Teacher Education* Vol. 6, No. 1, June 2016, 67-85

Murray, J. W., & Hammons, J. O. (1995). Delphi: A Versatile Methodology for Conducting Qualitative Research. *The Review of Higher Education*, 18, 423.

Niemi, H., & Multisilta, J. (2016). Digital storytelling promoting twenty-first century skills and student engagement. *Technology, Pedagogy and Education*, 25(4), 451-468

Pai, J. C., & Tu, F. M. (2011). The acceptance and use of customer relationship management (CRM) systems: An empirical study of distribution service industry in Taiwan. *Expert Systems with Applications*, 38(1), 579-584

Paraskeva, F., Bouta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers & Education*, 50(3), 1084-1091

Prakash, B. K. (2014). Digital Pedagogy and Its Arrival in Teacher Education. *RJPSSs* 2014 No.1-17

Ridzwan Che Rus, Ruhizan M Yasin, & Mohammad Sattar Rasul. (2014). From zero to hero: Becoming an employable knowledge worker (k-worker) in Malaysia. In *Regional Cooperation Platform for Vocational Teacher Education and Training in Asia.* Shanghai, China

Sailin, S. N. & Mahmor, N. A. (2018). Improving Student Teachers' Digital Pedagogy Through Meaningful Learning Activities. *Malaysian Journal of Learning and Instruction*, Vol. 15 (No. 2) Dec 2018: 143-173

Salleh, H. & Abdul Manaf, M. (2017). Pengintegrasian Pembelajaran Teradun Dalam Pembelajaran Berasaskan Kerja. [*Integration of Blended Learning in Work-Based Learning*]. *Jurnal Kejuruteraan, Teknologi dan Sains Sosial* Vol. 1 Issue 1 (Special Issue - NaCoSC'17)

Siraj-Blatchford, I., Sylva, K., Taggart, B., Sammons, P., & Melhuish, E. (2003). *Technical paper 10 – case studies of practice in the foundation stage*. London: Institute of Education

Slavin, R. E. (1997). *Educational Psychology: Theory and Practice*. Virginia: Allyn and Bacon

Sulaiman Ngah Razali (1997). *Pedagogi Teori dan Praktik*, [Pedagogy Theory and Practice], Kuala Lumpur: Dewan Bahasa dan Pustaka

Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I. & Taggart, B. (2011). Pre-School Quality and Educational Outcomes at Age 11: Low Quality Has Little Benefit. *Journal of Early Childhood Research*: 109-124

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education*, 57(4), 2432-2440

Teo, T., & Zhou, M. (2017). The influence of teachers' conceptions of teaching and learning on their technology acceptance. *Interactive Learning Environments*, 25(4), 513-527

Toktarova, V. I. & Semenova, D. A. (2020). Digital pedagogy: analysis, requirements and experience of implementation. *J. Phys*.: Conf. Ser. 1691 012112

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). "Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence*": Erratum. Educational Technology Research and Development*, 65(3), 577. https://doi.org/10.1007/s11423-016-9492-z

Umek, L., Keržič, D., Aristovnik, A., & Tomaževič, N. (2017). An assessment of the effectiveness of Moodle e-learning system for undergraduate public administration education. *International Journal of Innovation and Learning*, 21(2), 165–177

Vaataja, J. O. & Ruokamo, H. (2021). Conceptualizing dimensions and a model for digital pedagogy. *Journal of Pacific Rim Psychology*. Volume 15: 1–12

van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in human behavior*, 72, 577-588

Wang, C. S., Jeng, Y. L., & Huang, Y. M. (2017). What influences teachers to continue using cloud services? The role of facilitating conditions and social influence. *The Electronic Library*, 35(3)

Zohar, A., Degani, A., & Vaaknin, E. (2001). Teachers' beliefs about low achieving students and higher order thinking. *Teaching and Teacher Education*, 17, 469-485

Zuraini Zakaria, Fatimah Hassan, Hasmawati Hassan, & Noresah Mohd Shariff (2006). Cabaran pendidikan secara jarak jauh: Kesedaran dan pendedahan dalam era teknologi maklumat dan komunikasi (ICT). *Laporan Penyelidikan Pembiayaan Geran Penyelidikan USM Jangka Pendek*. Pusat Pengajian Pendidikan Jarak Jauh. Pulau Pinang. Universiti Sains Malaysia. [*The challenge of distance education: Awareness and exposure in the era of information and communication technology (ICT). Short Term USM Research Grant Funding Research Report. Center for Distance Education. Penang. Universiti Sains Malaysia]*.