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The Readiness of TVET Lecturers in Facing the Intelligence Age IR4.0

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Abstract: Understanding of the industrial revolution 4.0 (IR4.0) and professional ethics are required for lecturers to cope with the intelligence era. However, some lecturers still have poor professional ethics or do not even understand such principles. These two factors have become barriers to the country's efforts to embrace IR4.0. Thus, this study aims to determine the influence of professional identity and ethics on the readiness of TVET lecturers in facing IR4.0. Data were collected using a combination of two instruments to measure professional ethics, IR4.0 understanding and IR4.0 readiness. A total of 203 technical and vocational education and trainings (TVET) lecturers in Malaysia were chosen for this study by using the simple random sampling method. The findings reveal the significant influence of lecturers' understanding of the intelligence age and their readiness to face IR4.0. However, professional ethics is not found to be a mediator of the relationship between IR4.0 understanding and readiness. Thus, the Ministry should improve the lecturers' IR4.0 readiness by providing IR4.0 courses and trainings for lecturers, as well as providing state-of-the-art facilities for teaching and learning technology.

Keywords: Challenges, readiness, industrial revolution, technology

1. Introduction

We are now in the industrial revolution (IR) 4.0 era that is characterised by rapid technological development, as evidenced by the internet that has led to a borderless world. Hence, IR4.0 is one of the most important references and developmental focus of the country. From the steam era, to electricity, and to computerisation, we are now advancing toward the intelligence era. The Ministry of Higher Education has laid out a foundation to ensure that public higher education institutions (IPT) in Malaysia continue to produce a well-developed workforce in line IR4.0 (Azman & Ibrahim, 2018). Hence, IPT should similarly move forward with strategies of high technology that include IR4.0 as one of the agendas, as well as prepare lecturers to advance in line with national requirements. Lecturers' readiness to face IR4.0 is crucial, particularly in producing workers for global employment. IR4.0 involves automation technology that presents new challenges to all sectors in the country because of the changes in line with digital transformation to retain competitiveness. IR4.0 involves the invention of new technologies, such as automation, internet of things (IoT), analysis and big data, simulations, system integration and robotics and cloud utilisation, all of which would accelerate the development of the modern world (Schwab, 2016).

Technical and vocational education and trainings in Malaysia were rebranded as TVET in an effort to steer the nation towards higher levels of education (Ibrahim, Baharuddin & Baharom, 2018). TVET comprises higher education and are

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expected to change due to IR4.0. All lecturers must therefore prepare for challenges and transformation in higher education. The aim is to ensure that teaching and learning methods are advancing together with the current IR4.0.

Educators are expected to experience challenges as they are teaching the digital generation, who has different learning styles that mostly involve the aid of communication and technology (Rahim & Shamsudin, 2019). In addition, this generation gains information from multiple and various sources and channels. The roles and tasks of lecturers have also changed as they are no longer expected to merely lecture but also curate basic knowledge for their students (Ibrahim, Baharuddin & Baharom, 2018). Hence, lecturers should solidly arm themselves with new skills before facing the Z generation (D'Souza & Mudin, 2018).

Institutions or centres that offer learning streams for skills are the national sources of skilled and semi-skilled workers in various fields (Yussof, Ahmad & Aziz, 2018). In this regard, lecturers train and develop the required workforce to help the country advance towards industrialisation. Hence, lecturers should have the right attitude and positive values, such as discipline, diligence and dedication. Industrial technology especially requires a disciplined workforce that is equipped with a broad base of skills and positive culture and work ethics (Juhan, 2012). Education is the entrance to the intelligent era, and as educators, lecturers are the keys to producing a generation that is ready to face such era. Lecturers are required to embrace certain criteria, such as professional knowledge and ethics, which enable them to produce an intelligent generation. However, studies have found that most lecturers in Malaysia have yet to fulfil these criteria (Yusuf, Ahmad, Awang, 2018). Thus, with unresolved questions on lecturers' readiness towards the era of intelligence, how can IR4.0 be achieved?

Several lecturers at TVET institutes have yet to find the most suitable teaching and learning methods (Nordin, 2011). According to Samsudin, Hassan and Hassan (2013), the drawbacks in achieving meaningful teaching and learning sessions include the lecturers themselves who have yet to utilise and apply sustainable resources in their teaching programs. This finding is in agreement with that of Paryono and Quito (2010), who stated that TVET has a significant role in implementing and encouraging sustainable development as it is the main agent for the frontline workforce, which has direct contact with sustainable issues. In other words, TVET is not only educating for sustainable development but also practising it through policies and practices that are inculcated by lecturers.

Previous research findings have revealed that TVET lecturers are not fully ready and do not really understand how to apply IR4.0 (Azman & Ibrahim, 2108; Ibrahim et al., 2018; Shafei, Haris, Hamzah, 2018). This deficiency is the barrier to the efforts to achieve the targeted IR4.0, which requires the nation to be technology savvy. Hence, relevant parties need to take remedial steps to overcome these problems and thereby achieve a smooth process of technological-based teaching and learning. The Malaysian government has equipped most urban and rural schools with technological facilities. Unfortunately, most teachers fail to fully utilise these facilities (Arifin et al., 2018).

The significant aspects in realising IR4.0 are ethics, morale and identity. Future lecturers are those who are capable of carrying out their responsibilities with great ethics, morale and clear identities. Several issues have been revealed, including one wherein some trainee teachers do not fully understand or follow professional ethics (Bok, 2006). TVET institute that offers skills trends to produce skills and semi-skills workers in various fields (Yussof, Ahmad & Aziz, 2018). In that regard, to train and develop the required workforce towards industrialized countries, students need to be trained to have the right attitude and positive values such as discipline, diligence and dedication (Yussof, Ahmad & Aziz, 2018). Technologies industry requires a disciplined workforce, equipped with a broader based on skills and has a positive culture and work ethic (Juhan, 2012). The skills should be based on the technologies that are available and applied in each respective industry (Amiron, Latib & Subari, 2019).

Teaching ethics should be observed to uplift the teaching profession. As such, lecturers are expected to uphold the responsibilities entrusted to them by conducting their duties consistently and professionally, as well as cementing relationships with other colleagues. However, some lecturers breach professional principles. In addition, lecturers must be knowledgeable not only of their profession but also of their roles as educators for the benefit of students, the society and the nation in general (Akhiar, Shamsuddin & Jusoh, 2012). According to the problem statement, they are determining the significant factors that influence lecturers' readiness in facing the intelligent era. This study also intended to investigate the mediating effects of professional ethics on relationships between IR4.0 understanding and IR4.0 readiness.

2. Methodology

This study implemented quantitative research method in attempt to generalize the research findings and are typically interested in prediction (Harwell, 2011). A correlational survey research design was used as it is in line with the objective of this study which is to find the relationship between variables under study.

2.1 Research Design

The present research aims to examine the relationships between understanding and professional ethics and the effects of such relationships on IR4.0 readiness by using structural equation modelling (SEM) (Byrne, 2012; Piaw, 2014; Hoyle, 1995). A correlation survey was conducted to determine IR4.0 readiness, IR4.0 understanding and professional ethics amongst TVET lecturers in Malaysia. Piaw (2006) stated that a survey is a method for collecting sample information by

using a questionnaire that respondents are required to answer independently. Figure 1 indicates the Priori model that shows the integration of variables developed from theories and previous studies. The three main variables are understanding, professional ethics and IR4.0 readiness, and their correlation is indicated by the straight arrows. On the basis of relevant literature, the model integrates these variables that were not examined previously, and SEM is used to evaluate the fit of this model.

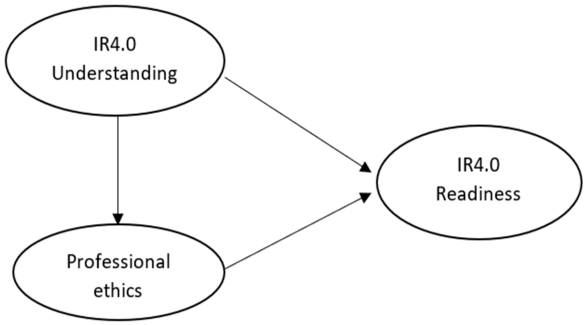

Fig. 1 - Priori model (Hutkemri & Zamri, 2017)

2.2 Participants

The population of the current research consisted of TVET lecturers in Selangor, Malaysia. The simple random sampling method was used to select the participants. Patton (1990) mentioned no rules in determining the sample size but preferred a big sample for research surveys using a questionnaire. Sudman (1976) asserted that a minimum of 100 elements are required for each major group or subgroup in a sample. The current research involved 203 lecturers in Malaysia. Of the respondents, 86 (42.4%) were male lecturers, and 117 (57.6%) were female lecturers. In terms of teaching experience, 45 (22.2) lecturers have below 5 years of teaching experience, 71 (35.0%) have 5 to 10 years, and 87 (42.9%) lecturers have 10 years or more. The respondents completed a questionnaire that included five items on IR4.0 readiness, IR4.0 understanding and professional ethics.

2.3 Measurement

The scales to measure understanding and IR4.0 readiness were adapted from Hutkemri & Zamri (2017), whilst the scale to test professional ethics was adapted from Buntoro (2014). These scales were used as data collection tools for the present study. A five-point Likert scale ranging from 1 (‘strongly disagree’) to 5 (‘strongly agree’) was employed to measure professional ethics, IR4.0 understanding and IR4.0 readiness. This questionnaire was referred to two experts to verify its validity. Validity refers to the accuracy and truthfulness of a tool for measuring an instrument. Before an actual study is carried out, the instrument must first go through a process to test its validity and ability to measure what should be measured (Pallant, 2013). After amendments were made on the basis of the recommendations given by the experts, the pilot study was conducted on 50 TVET lecturers in Bangi, Malaysia. The pilot study aimed to test the understanding of the respondents on the accuracy and appropriateness of terms, sentence structure and use of language, thereby reducing the format and words in the item–item questionnaire (Baba, 1997). The results of the pilot study were processed using SPSS version 25.0, with a few items tested using Cronbach’s alpha to measure their reliability. According to Konting (1997), Cronbach’s alpha values between .60 and .80 are acceptable, and values less than .60 are considered low and unacceptable. The results of the pilot study indicated that the questionnaire items had high reliability in the range of .78–.96 (professional ethics, $\alpha = .96$; IR4.0 understanding, $\alpha = .91$; IR4.0 readiness, $\alpha = .78$).

2.4 Data Analysis

Data analysis was conducted in three steps. The first step considered significant data screening-related issues, such as handling of missing data, multi-collinearity, and identification of outliers and normality by using the Statistical Package for the Social Sciences 23.0 software. Outliers were identified through a boxplot for each sub-construct. For the examination of normality, the skewness and kurtosis values of each item ranging from −1.96 to +1.96 at the 0.05 significance level (Hair, Black, Babin, & Anderson, 2010) were used. In terms of multi-collinearity, the correlation amongst factors should be less than 0.90 (Kline, 2005). In the second step, confirmatory factor analysis (CFA) and descriptive statistics were conducted. CFA using AMOS 18.0 was performed to explore whether the established dimensionality and the factor-loading pattern fit the Malaysian context. Moreover, a measurement model was examined between the related variables for each construct developed from theories and empirical studies. In the final step, an a priori model was evaluated. The fit indices of the measurement and the structural models were also tested in reference to specific criteria.

Indirect effects were analysed using a bootstrapping procedure with the bias corrected percentile method (Guan, 2003). This procedure produced an empirical representation of the sampling distribution of the mediating effect by managing the acquired sample of size *n* as a representation of the population in miniature (Hayes, 2009). This procedure was replicated for a total of *k* times (typically at least 1,000). Exactly 5,000 sub-samples for bootstrapping procedures are recommended, but the current research employed the maximum likelihood bootstrapping procedure with a bootstrap sample of 1,000 and a bias correction confidence interval of 95% (Mohamad, Mohamad, Ali & Awang, 2018). Byrne (2013) and Guan (2003) validated that the bootstrapping procedure in the AMOS program is suitable to manage non-normal data.

Goodness of fit was examined by using the chi-square ($\chi 2$) ($p>.05$), comparative fit index (CFI>.90), Tucker Lewis index (TLI>0.90) and root-mean-square error of approximation (RMSEA<.08) (Awang, 2012). In addition, the Cronbach's alpha coefficients, Composite Reliability (CR) and Average Variance Extracted (AVE), were calculated. Cronbach's alpha was computed to determine the reliability of the instrument (total and sub-constructs). CR considers that indicators have distinct loadings, whereas AVE captures the variance of its indicator (Awang, Afthanorhan, & Asri, 2015; Mohamad, Mohammad, Ali, & Awang, 2018). Hair et al. (2010) reported that alpha values of .60 to .70 are satisfactory. CR should be more than .60, and AVE should be higher than .50 (Awang, 2012; Mohamad, Mohammad, Ali, & Awang, 2018).

3. Results

In the current research, the amount of missing data varied from 0% to .5% per item, and the missing items were completely random (MCAR) (Kline, 2005). Table 1 lists the means, standard deviations, correlation matrix and skewness and kurtosis for all variables.

Table 1 - Correlation matrix, means and standard deviations.

Variable	1	2	3
1. Professional ethics	1		
2. IR4.0 understanding	.75**	1	
3. IR4.0 readiness	.63**	.80**	1
Skew	-1.90	-1.02	-.59
Kurtosis	2.61	.30	-.23
Mean	4.65	4.26	4.01
SD	.61	.80	.71

** Correlation is significant at the 0.01 level (two-tailed)

Table 1 reveals a strong level of correlation (.63 to .80) between the constructs. The analysis revealed that the correlation between professional ethics and IR4.0 understanding ($r = .75$, $p<.01$), professional ethics and IR4.0 readiness ($r = .63$, $p<.01$) and IR4.0 understanding and IR4.0 readiness ($r = .80$, $p<.01$) were all significant and strong. This correlation indicates that the discriminant validities of the variables were attained because the correlation matrix yielded correlations of less than 0.90 (Kline, 2005). In terms of univariate normality, the preliminary analysis shows that all of the items of professional ethics, IR4.0 understanding and IR4.0 readiness reached univariate normality (skewness and kurtosis values ranged from −.23 to 2.61). The bootstrapping procedure was used to obtain accurate and stable parameter estimates for this dataset (Awang, 2012; Hayes, 2009). In addition, the mean values varied amongst the variables, with professional ethics at M = 4.65 and SD = .61, IR4.0 understanding at M = 4.26 and SD = .80 and IR4.0 readiness at M = 4.01 and SD = .71.

3.1 Testing the Hypothetical Structural Model

The outcomes of the SEM analysis revealed the hypothetical structural model at $\chi^2 = 363.64$, $\chi^2/df = 4.18$, RMSEA = .07, TLI = .90 and CFI = .90. All evaluations resulted in an acceptable model fit for the Malaysian context. All factor loadings of the three variables ranged from .50 to .93. The factor loading values exceeded the .50 desirable standard (Hair et al., 2010). Table 2 demonstrates that the hypothetical structural model is satisfactory.

Table 2 - Results of the hypothetical structural model.

Parameter	Coefficient
$\chi 2$	363.64
χ^2/df	4.18
RMSEA	.07
TLI	.90
CFI	.90

Note: χ^2: Chi-square goodness of fit; df: degrees of freedom; CFI: comparative fit index; TLI: Tucker Lewis fit index (TLI); RMSEA: root-mean-square error.

In addition, the CFA model presented in Figure 2 became the final model that indicated the relationships amongst professional ethics, IR4.0 understanding and IR4.0 readiness in the Malaysian context. The final model derived from the current research can be used as an alternative in explaining previous studies on the relationships between professional ethics, IR4.0 understanding and IR4.0 readiness.

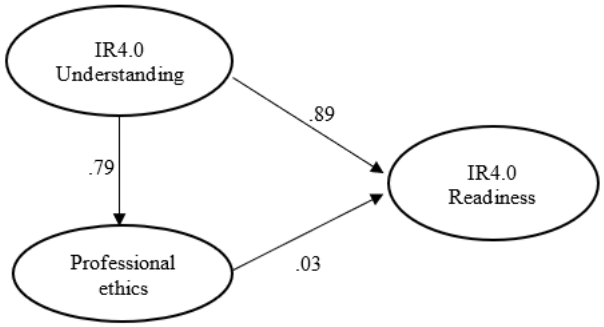

Fig. 2 - Final model of the study.

3.2 Relationships between IR4.0 Understanding and IR4.0 Readiness

IR4.0 understanding positively affected IR4.0 readiness. Significant relationships were noted between the two constructs (β = .89, t = 8.438, p<.01). Thus, the hypothesis that lecturers who observe professional ethics perform well in IR4.0 readiness was fully confirmed.

3.3 Relationships between IR4.0 Understanding and Professional Ethics

IR4.0 understanding positively affected professional ethics. Significant relationships were noted between the two constructs (β = .79, t = 13.49, p<.01). Thus, the hypothesis that students who utilise IR4.0 understanding show positive professional ethics was fully confirmed.

3.4 Mediating Effects of Professional Ethics on Relationships between IR4.0 Understanding and IR4.0 Readiness

Professional ethics did not show a mediating effect on the relationship between IR4.0 understanding and IR4.0 readiness. Table 3 lists the results of the mediating effect analysis using the bootstrapping procedure.

Table 3 - Output of mediating effect

Path	Direct effect		Indirect effect		Result
	β	P value	β	Nilai P	
U -> PE -> R	.89	.001	.03	.769	Full mediation

Note: PE: professional ethics; U: IR4.0 Understanding; R: IR4.0 readiness.

Table 3 illustrates the outputs of the mediating effects of professional ethics as determined using the bootstrapping procedure, wherein only a positive partial mediating effect (β = .03, p>.05) for IR4.0 understanding on IR4.0 readiness (β = .89, p<.01) was found.

4. Discussion

This study determined that professional ethics amongst TVET lecturers are high. Lecturers have respectable responsibilities and tolerance in carrying out their tasks. Similarly, they provide a good quality of teaching service, which is actually a basic requirement to produce quality students. This statement supports Ayub (2005), who stated that an educator should deliver a great quality of service and provide a wide range of skills. This emphasize to the Malaysia government policy on IR4.0, the policy envisions Malaysia as a strategic partner for smart manufacturing, primary destination for high-technology industries and total solution provider for manufacturing sector and related services in the region (MITI, 2018). TVET lecturer need to produce highly creative graduates with the ability to think creative and competent to serve the industry.

In addition, TVET lecturers have embraced a sound understanding of IR4.0. Lecturers have great collaboration and apprehension on the current global development issues. This finding supports those of Ibrahim et al. (2018) who also found that the IR4.0 understanding of TVET lecturers is at the moderate level. By contrast, Rase (2013) stated that lecturers have a low level of knowledge. At present, the education system should focus on learning where to lean towards IR4.0 in order to produce holistic, creative, inventive and critical graduates. Hence, stakeholders and relevant sectors should work together in discussing various efforts and actions to be taken to face coming changes (Azman & Ibrahim, 2018). Failure to introduce and implement the IR4.0 policy would put institutions at a disadvantage in the global competition (Ahmad, 2017). Thus, lecturers need more exposure to the ways through which they can empower themselves in managing IR4.0 requirements (Abdullah, Hoque, Ramlan & Shafee, 2019). All these needs can be met through extensive training and human resource development (Makhbul, 2018).

IR4.0 readiness remains at a moderate level and thus needs further enhancement. This finding is the same as those of Ibrahim et al. (2018) and Shafei et al. (2018). TVET lecturers perceive that the IR4.0 courses organised by the Ministry are still insufficient, and they highlight the lack of funds to support themselves if they are to enrol in IR4.0 courses without Ministry support. According to the research findings, the Ministry of Education clearly needs to provide additional courses and training to introduce IR4.0 to TVET lecturers. This result is in line with those of Nordin (2011), who stated that serious commitment from the organisation is necessary in order to shift one's readiness, particularly through courses and training. Most importantly, such courses and training must be free of charge or require minimal financial charges. This effort should enhance the IR4.0 readiness and improve the self-confidence of TVET lecturers. Meanwhile, all lecturers have to be ready to attend relevant courses and training organised by the Ministry from time to time.

This study determined a positive direct effect of IR4.0 understanding on IR4.0 readiness, with the former enhancing the latter. This finding supports those of Ilias and Ladin (2018), who found a significant correlation between understanding and readiness. A positive direct effect of IR4.0 understanding on professional ethics was also found, with the former enhancing professional ethics amongst TVET lecturers when high. However, we must note that professional ethics do not mediate the relationship between IR4.0 understanding and IR4.0 readiness. That is, TVET lecturers do not need professional ethics to enhance their IR4.0 readiness, but they do require IR4.0 understanding. Therefore, any future plan to enhance lecturers' IR4.0 readiness should consider their IR4.0 understanding. Efforts should include organising courses and training for lecturers, as well as providing state-of-the-art facilities for teaching and learning technology. This result supports those of Xing and Marwal (2017) who stated that universities should be interdisciplinary in their offerings, such as providing virtual lecture rooms and libraries. In addition, lecturers have to be competent and ever ready to execute their teaching and learning in the IR4.0 era.

5. Conclusion

This study serves as the foundation for future research. The findings and information gathered from this study could become a valuable reference for other parties in implementing IR4.0 at higher education levels. This study contributes a new IR4.0 lecturers' readiness model, which involves two main factors, namely, professional ethics and IR4.0 readiness. Other relevant factors could also influence the implementation of IR4.0, and they include the use of technology, identity, morale and ethics. Future researchers could consider these factors to gather in-depth information on IR4.0 implementation amongst lecturers.

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