Towards Educator 4.0: Technology Competency-based Teaching

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Abstract

Educator 4.0 is a new concept that describes the characteristics of future educators capable of handling and implementing various smart technologies into their teaching methods and strategies. Since the education system has rapidly changed due to the digital and smart technology transformation, educators especially in Higher Learning Institutions are required to upgrade their teaching skills and become more competent to meet the needs of the new generations of students. There is not much discussion on Educator 4.0 and how it can be measured. This is also due to the limited literature globally, thus there is a need to develop new instruments and models to measure the 4.0 Educators' competency. The theories of Technological Literacy and DigCompEdu were adapted to develop this new instrument model. Factors and constructs such as 4.0 technological literacy, 4.0 technological resources, and student empowerment were identified and used to measure the level of 4.0 competencies among the educators. Non-probability sampling method with convenience sampling was used to collect the data from the respondents in Pre-University Institutions represented by Kolej MARA and Kolej Profesional MARA lecturers on the east coast of Malaysia. A PLS-SEM approach was used to validate this new instrument model. The findings reveal that the instruments developed were valid and all constructs have a positive relationship with the Educator 4.0 competency. All constructs were good at measuring the Educator 4.0 competency. The findings of the study also will provide a better understanding of educators' 4.0 competency regarding the context of the study. Besides, this study also will enrich the literature on 4.0 Educators' competency.

Keywords **:** *Education 4.0; Educator 4.0; Pre-University; Teaching Competency; Technology 4.0*

I. INTRODUCTION

Educator 4.0 is a concept first introduced by Abdulrazeq et al. [1] to describe the characteristics of future educators who can handle various technologies and implement them efficiently in their teaching. The term Educator 4.0 is still limited in use either at the national or global level. The most recent study that uses this term is the study by Peredrienko et al. [32]. He explained that Educator 4.0 is a concept created as a response to the needs of the Industrial Revolution 4.0 and it is easier to describe the characteristics of teaching and learning by educators based on this technological revolution. The ability of educators to go through the digital era in the educational process and their willingness to adapt to the frequently changing educational environment is an important issues to discuss [32]. Changes to the teaching style need to be done frequently to ensure that lecturers remain competent and that they are in line with the latest education system [14; 20]. To achieve an excellent level of teaching competency, it needs to be supported with the use of various technologies [30; 23; 28; 4; 40].

Educators 4.0 are individuals who can master the latest technology skills, are knowledgeable and can solve technology-related problems such as technical problems, security, and control systems. They also understand and adhere to the ethics of online technology use. This knowledge and expertise should then be used to guide and empower students' skills. However, there is limited research conducted to test the level of Educator 4.0 competencies among lecturers. The exposure and awareness regarding the characteristics of Educator 4.0 is low and lacks attention. There is a study done in Pakistan, and it is found that the limitation of knowledge regarding the use of 4.0 technologies caused their education system to be stuck at the stage of Education 2.0 progress [6]. This statement is supported by Alda et al. [2] who reported that in the Philippines, they need more support from the government in providing infrastructure that can help the implementation of Education 4.0. This limitation causes the level of

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competency in the use of 4.0 technologies to be low and difficult to measure. This includes assessing whether educators have the criteria and characteristics required for Educator 4.0. From all of these problems, it is clear that there are limited studies regarding Educators 4.0 competency globally specifically in Asia countries. Therefore, a new instrument and model were built to identify the appropriate elements and constructs that can measure and contribute to the level of competency for Educator 4.0.

II. LITERATURE REVIEW

To understand the various determinants that may influence Educator 4.0 competencies, this section discusses various theoretical frameworks that are used in measuring teaching competencies aligned with the use of 4.0 technologies. Two prominent models and theories are adapted and integrated into this Educator 4.0 competencies framework model which are DigCompEdu [36] and Technological Literacy [17].

A. Technological Literacy

Technological Literacy Theory originally emphasized knowledge of digital technology concepts. In this study, the use of digital technology will be replaced by the term Technology 4.0 [24]. This literacy refers to knowledge and understanding of the concept of Technology 4.0. Resouglu and Cebi [37] explain educators who have an understanding and knowledge of technology are more likely to use technology frequently than in their teaching. This knowledge then becomes a good experience for them to upgrade their existing teaching methods. It also refers to the awareness and sensitivity of the educators in parallel with the technology used to the current needs [25; 19; 42]. It includes the level of readiness to accept and adapt to various technologies including smart technology in their daily life [22]. Technological Literacy Theory by Hovde and Renguette [17] lists three important criteria to be measured, (i) knowledge; (ii) understanding, and (iii) awareness. Literature shows that these three elements are important to represent technological literacy and they should have contributions to competencies [37; 38; 3; 29; 41]. This element should be adapted to the new construct by implementing Technology 4.0 and to see how this literacy might contribute to the educators' competency. Thus hypotheses were developed:

H1: Technology Literacy 4.0 has a positive contribution to the competence of Educators 4.0

B. Technological Resources

Technological resources are constructs adapted from the DigCompEdu model to measure individual skill levels in providing teaching resources and materials. It also measures the skill level of individuals in creating new resources through the use of technology and sharing the resources produced for use by others. Digital resources and their applications have a significant influence on the acquisition of digital teaching competence [12]. Redecker [36] believes that an educator who is skilled in utilizing existing technology resources contributes to the improvement of teaching competence positively. The educator has an advantage in integrating resources and existing technology into their teaching techniques [9]. A study conducted by Dias-Trindade & Albuquerque [8] shows that educators who are less skilled in using various technology resources have a low level of competence while educational individuals who are active and skilled in using various technological resources have a higher level of teaching competence. Hence, the second hypothesis would be:

H2: Technology Resources 4.0 has a positive contribution to the competence of Educators 4.0

C. Students' Empowerment

Student empowerment measures an individual's ability to use technology to enhance student participation and learning. This construct also measures the level of ability of individuals or teaching staff to produce teaching methods that are more personal or individualistic to ensure that the methods used can meet the needs of students with different levels of learning. It is the lecturer's responsibility to ensure that they can guide students to add both their skills [33]. Past studies show that technology increases access to educators and students, providing more up-to-date learning resources and they can access the materials anytime and anywhere [26].

Educators in Higher Learning Institutions are responsible for being facilitators to students not only in imparting knowledge and teaching skills technically [33] but also in enhancing students' technological skills. Educators should also be able to guide students when facing technological challenges and solving any problems related to Technology 4.0. A study by Reisouglu & Cebi [37] conducted on pre-service educators in Turkey, shows that every educator who has technology skills will indirectly benefit their skills to students. Research data shows that half of the respondents educators who have technology skills will use it to produce better teaching methods to attract the attention of their students. Thus, the third hypothesis would be:

H3: Student empowerment has a positive contribution to the competence of Educators 4.0

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D. Teaching Competency

The quality and competence of teaching in Higher Learning Institutions are very important to ensure effective learning outcomes in producing excellent students. It is also important to meet the requirements and criteria for appointment or promotion [20]. To achieve an excellent level of teaching competence, it needs to be supported with the use of technology as reported by many previous studies [30; 23; 28]. However, the extent of the use of Technology 4.0 can form a competent Educator 4.0, especially in institutions of higher education has not yet been proven. Thus an appropriate instrument model can be developed to measure the effect of each construct on the competency level of educators in applying technology 4.0 in their teaching known as Educator 4.0. Figure 1 shows a conceptual research framework for Educator 4.0 competencies. The three main constructs are 4.0 technological literacy, 4.0 technological resources, students' empowerment, and 4.0 competencies. All constructs were hypothesized to influence Educators' 4.0 competencies.

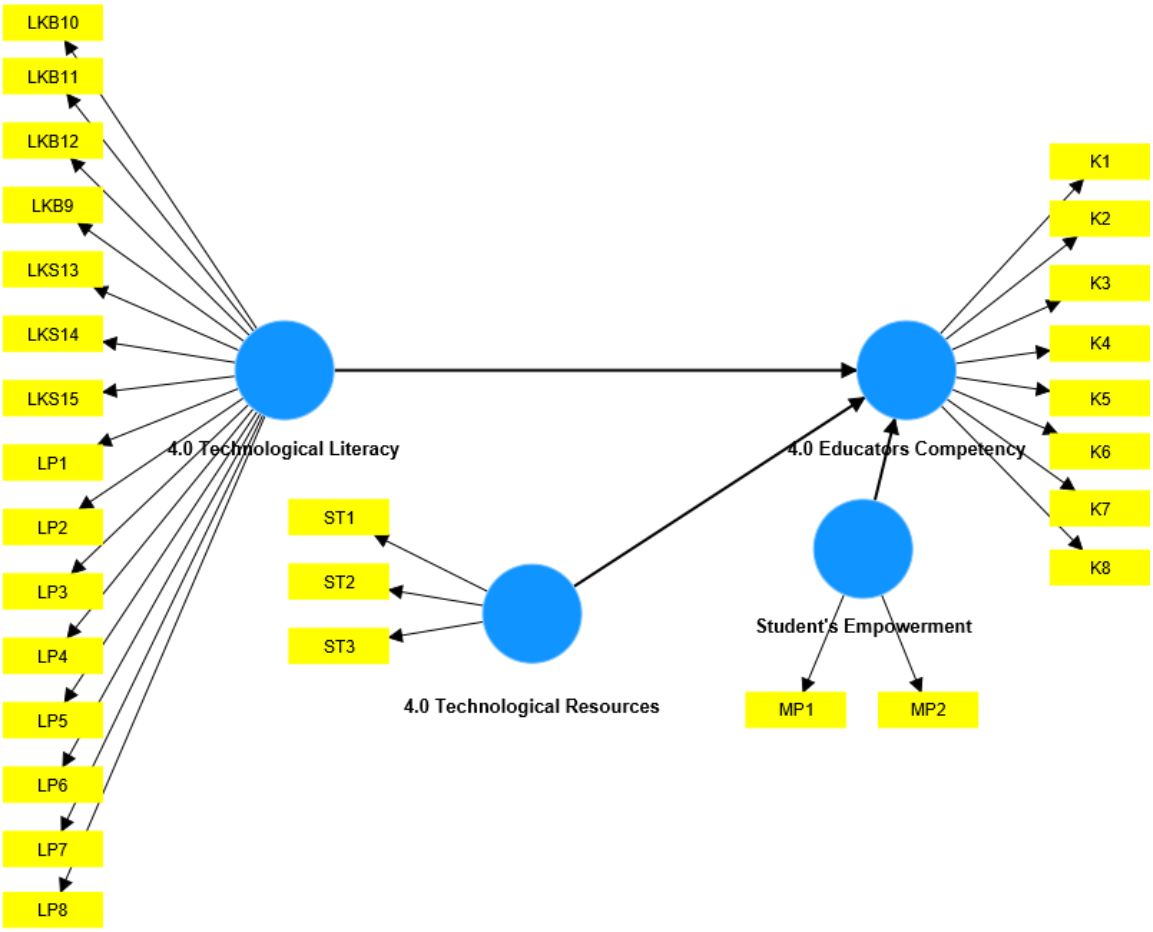

Figure 1 Educator 4.0 Competencies Research Framework

III. RESEARCH METHODOLOGY

Applying the non-probability sampling technique with the purposive sampling method, data were collected among lecturers who are teaching at the Pre-University Institution of Kolej MARA and Kolej Profesional MARA all around Malaysia. Using a self-administered technique, more than 300 potential respondents were approaching, with only 274 being collected with a complete filled-up questionnaire. Granting to the G-Power software, which was used to work out the minimum sample

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size using the power of analysis as offered by Hair et al [15] with an effect size of 0.15, margin error of 5%, and power of 80% [10], the minimum sample size required to examine the research model is 103. Thus, the sample size is sufficient to test the research model of the study. On top of that, all items were adopted and adapted from validated measurements from previous studies. Items for 4.0 technological literacy are adapted from Bliksteion et al. [5], 4.0 technology resources and student empowerment are adapted from Redecker [36] and items for 4.0 competency were adapted from Ismail and Jarrah [18].

IV. RESULT AND DISCUSSION

The data were analyzed using Smart PLS 4.0.9.9 to test the hypothesis of the study. Smart PLS is suitable for the study that focuses on predictive purposes [39]. Hence, Smart PLS was applied for the study for predictive purposes. Before examining the research framework, a preliminary analysis should be performed which includes an outliers analysis, the common method variance, and the normality test. Common Method Variance (CMV) should be remedied if the data used a single source data, and data were collected at the same time to measure the exogenous and endogenous variables of the study [35].

The study applied both procedures; procedural and statistical methods to confirm that there is no issue of CMV in the study. As proposed by Podsakoff et al. [34]; for procedural remedy, the study used different scales to measure exogenous and endogenous variables, which are from 1-5 and 1-7 respectively. For the statistical method, all variables were regressed against common variables using full collinearity analysis and if the value of the variance inflation factor (VIF) is the same or less than 3.3 then, there is no bias from single source data [21]. The analysis of this study resulted in a VIF of less than 3.3, thus indicating that the study has not suffered the CMV problem. As proposed by Hair et al. [15] and Ngah et al. [31], the study assessed the normality of the data using software available at Web Power Statistical Power Analysis online. The results revealed that the data was not multivariate normal, Mardia's multivariate skewness (β = 4654.309, $p<0.01$) and Mardia's multivariate kurtosis (β = 1681.766, $p< 0.01$), thus we proceeded to use Smart PLS which is a non-parametric analysis software.

A. Measurement Model

There are two stages of data analysis, which are the measurement model and the structural model. For the measurement model, the study needs to test the convergent validity and discriminant validity. Convergent validity is tested from the loadings that are higher than 0.5, composite reliability (CR) higher than 0.7, and the average variance extracted (AVE) higher than 0.5 [15]. Based on Table 1, all constructs in the research framework meet the minimum threshold values, thus indicating that convergent validity has been established in the study.

Table 1: Measurement Model

Construct	Item	Loading	CR	AVE
4.0 Technological Literacy	LP1	0.655	0.870	0.690
	LP2	0.735		
	LP3	0.770		
	LP4	0.604		
	LP5	0.777		
	LP6	0.758		
	LP7	0.585		
	LP8	0.765		
	LKB9	0.821		
	LKB10	0.879		
	LKB11	0.877		
	LKB12	0.770		
	LKS13	0.862		
	LKS14	0.878		
	LKS15	0.829		
4.0 Technological Resources	ST2	0.875	0.819	0.607
	ST3	0.818		
	ST4	0.620		
Student's Empowerment	MP1	0.860	0.873	0.775
	MP2	0.900		
4.0 Competencies	K1	0.602	0.890	0.506
	K3	0.750		
	K4	0.739		
	K7	0.616		
	K8	0.749		
	K9	0.647		
	K11	0.779		
	K12	0.783		

**Notes: ST1, ST5, MP3, MP4, K0, K2, K5, K6, K10 and K13 was dropped due to low loading*

There are many ways to measure the discriminat validity, but the latest literature by Henseler et al. [16] proposed that the study must use the heterotrait-monotrait (HTMT) ratio of the correlation techniques. The discriminant validity of the study has been fulfilled since all values in Table 2 do not violate the minimum value of 0.85 [16].

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Table 2: Discriminant validity

	4.0 Competencies	4.0 Technological Literacy	Student's Empowerment	4.0 Technological Resources
4.0 Competencies				
4.0 Technological Literacy	0.515			
Student's Empowerment	0.740	0.365		
4.0 Technological Resources	0.823	0.501	0.540	

B. Structural Model

The variance inflation factor (VIF) value which is less than 3.3 [7] is crucial to confirm that collinearity is not a significant issue in the study. As illustrated in Table 3, all VIF values were less than the threshold value set [7], thus confirming that VIF is not a problematic issue in the study.

For the hypothesis testing, a bootstrapping technique with 5000 resampling techniques was applied. The path coefficient estimates will be measured by the significance and confidence interval [15]. From the analysis, it was found that, for the H1, (β = 0.108, t = 2.273: LL = 0.027, UL 0.182, p = 0.012), thus H1 was supported. For H2, (β = 0.197, t = 3.91: LL = 0.114, UL 0.279, p = 0), thus H2 was supported. For H3, (β = 0.207, t = 4.173: LL = 0.132, UL 0.293, p = 0), thus H3 was also supported. Table 3 illustrates the result for all the direct relationship hypotheses of the study.

Table 3: Hypothesis Testing

Hypo	Relationship	Direct Effect, Beta	Se	Confidence Interval		T Value	P Value	Decision	VIF
				(LL)	(UL)				
H1	4.0 Tech Lit → 4.0 Comp	0.108	0.047	0.027	0.182	2.273	0.012	Supported	1.447
H2	4.0 Tech Res → 4.0 Comp	0.197	0.05	0.114	0.279	3.91	0	Supported	1.667
H3	Student's Emp → 4.0 Comp	0.207	0.049	0.132	0.293	4.173	0	Supported	1.512

V. CONCLUSION

The study assessed the contributing factors towards the 4.0 Educators Competencies. The study disclosed that the variable adapted from the Technological Literacy theory by Redecker [36] which is 4.0 Technological Literacy has a positive relationship with the 4.0 Educators Competencies. Therefore, adding the new construct from this theory could improve the measurement construct and knowledge element that need to be assessed. Thus, confirming the capability of the theory to explain the factors that influence the 4.0 Educator Competencies. Hence, to increase the 4.0 competencies, the educator needs to have a good 4.0 technological literacy. Those elements could be raised by a better understanding and awareness among educators in Higher Learning Institutions on the importance of 4.0 Technology. Thus, H1 was found supported.

For the H2, the study found that 4.0 Technological Resources also found to have a positive relationship with the 4.0 Educator Competencies. This finding corroborated the resolution from Guillén-Gámez et al. [12]. It records that, educators who actively use a variety of 4.0 technological resources in their teaching contribute to a better level of 4.0 competencies. Educators who have high access to 4.0 Technology and frequently adapt the 4.0 tools in their teaching produce creative methods that attract more attention to students. Wang et.al [40] supported this finding by stating that educators who integrate their teaching with 4.0 technology contribute to better skills and competencies. As a result, students will be more motivated and can also actively participate in class. Hence, H2 was supported.

For H3, it was found that student empowerment has a positive relationship with 4.0 Educator Competencies. As stated by GuillénGámez & Mayorga-Fernández [11], educator who highly integrated 4.0 teaching will encourage their students to have good skills in operating the 4.0 technologies. The concept of self-learning or personalized learning methods can be developed and adapted according to student abilities. This can also encourage students to be active and participate in the

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learning process. Hence, the construct of student empowerment has a contribution that is positive towards the competence of Educators 4.0.

The findings of the study revealed what are the factors towards 4.0 Educator Competencies. This finding is good for the Higher Learning Institutions in enlightening their academician towards their teaching quality. It is anticipated that the work will help them to arrive a good programs such as training and workshops to improve educators' 4.0 teaching skills and methods.

VI. THEORETICAL AND PRACTICAL IMPLICATIONS

This study can contribute to several practical aspects. The first contribution is to the production of the Educator 4.0 competency instrument, the addition of literature in the field of Education 4.0, and the addition to the study of the competency dimension. Due to the limitation of the Educator 4.0 competency instruments and model at the global level, this study is seen as an addition to a new, more practical model.

VII. LIMITATIONS AND FUTURE STUDIES

This study uses quantitative analysis as the main analysis method. Questionnaires are the main instrument for obtaining data sources. Among other suggested methods is to carry out a combined method of quantitative analysis and qualitative to strengthen the actual study. Experimental methods can also be done by using other constructs that are more appropriate to test the level of competence of Educators 4.0. Studies can be tested in different types of organizations and different levels of learning institutions [13]. Therefore, the expansion of this context is relevant and worthy of study.

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