

Understanding the 4.0 Industrial Revolution Impacts on How Students Aware of Opportunities and Challenges

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Abstract - The study was conducted to assess the impact of understanding the 4.0 industrial revolution on students' perception of opportunities and challenges. The research data were collected from a survey of 416 students studying at universities in Vietnam. Applying Structural Equation Modeling (SEM), the results showed that understanding about the 4.0 industrial revolution positively affects students' awareness of opportunities and challenges, in which students perceived the impact of challenges is higher than opportunities. Finally, the study proposed some recommendations to enhance students' understanding and awareness of the 4.0 industrial revolution.

Keywords: 4.0 industrial revolution, understanding, awareness, opportunities, challenges.

I. INTRODUCTION

In 2011, the definition of "industry 4.0" was first introduced at the Hannover Industrial Fair in the Federal Republic of Germany. The appearance of industry 4.0 in Germany has urged developed countries around the world to promote similar programs to maintain competitive advantages. The 4.0 industrial revolution has shown a combination of different technologies in the fields of physics, biology, and digital technology. It creates entirely new possibilities in the economic, political, and social systems. Artificial intelligence has brought plenty of achievements such as automated machines, autonomous vehicles, 3-dimensional printing (3D printing), nanotechnology, biotechnology, etc. It can be said that the 4.0 industrial revolution brings difficulties and challenges for developing countries, including Vietnam. As a developing country, Vietnam has the advantage of a young and abundant manual labor resource. However, the pressure of industry 4.0 has turned this advantage into potential risks for the young Vietnamese workforce in the future. Therefore, human resources must improve themselves including broadening knowledge and accessing new technology to avoid being eliminated from the competitive labor market.

According to [7], while countries are entering an era of economic development, workers are also racing to seek jobs. Hence, a strong knowledge base and a thorough understanding are necessary. Strategies on raising awareness and expanding vision for students are very important when society is constantly changing [2]. Also, the study by [2] indicated that the lack of knowledge and understanding greatly affects students' awareness. According to [5]

awareness depends deeply on the understanding of young people. The more an individual is confident in his or her understanding, the more he or she realizes the challenges to face and be well-prepared for them. The awareness of opportunities depends largely on subjective knowledge. From the above discussion, the study was conducted to evaluate how students' understanding of the 4.0 industrial revolution affects their awareness of opportunities and challenges; thereby proposing several recommendations to improve students' understanding and awareness about the 4.0 industrial revolution.

II. RESEARCH HYPOTHESES

As reported by [5], subjective and objective knowledge are correlated with each other. The more knowledge a person has, the more he or she believes in his or her understanding. [5] confirmed that objective knowledge has a positive relationship with subjective knowledge. In other words, the higher the practical knowledge of a person, the more confidence he or she puts in the understanding. The study tests the relationship between the two aspects of the understanding of the 4.0 industrial revolution. Therefore, the hypothesis is proposed as follows:

H1: Objective knowledge positively affects subjective knowledge of students about industry 4.0.

According to [5] the level of subjective understanding strongly affects the awareness of opportunities, especially that young people aged from 22 to 30 have a higher awareness level. Meanwhile, [16] have concluded that the impact of subjective knowledge on human behavior is more powerful than objective knowledge. Also, awareness is greatly affected by subjective knowledge. Thus, the following hypothesis is stated:

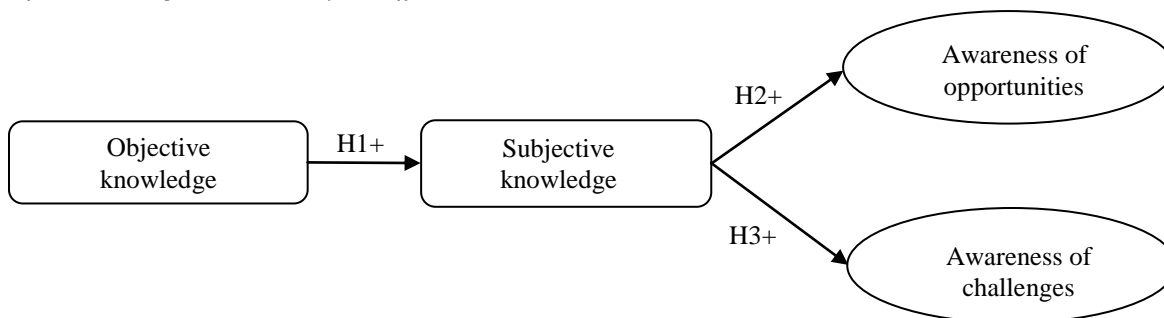
H2: Subjective knowledge positively impacts students' awareness of the opportunities that the industry 4.0 offers.

As stated in the study by [7], personal awareness is strongly influenced by subjective knowledge. The more an individual knows, the more challenges in the future he or she may see. [5] have suggested that the more a person trusts in his or her knowledge, the sooner he or she realizes the challenges they will deal with so that he or she has a better

preparation. From the aforementioned point-of-view, the study hypothesizes as follows:

H3: Subjective knowledge positively impacts students' awareness of the challenges that industry 4.0 offers.

The proposed research model on “the relationship between the knowledge about the 4.0 industrial revolution and students' awareness of opportunities and challenge” is as follow:



Source: The author's proposal, 2019

Figure 1: Proposed model research

Table 1: Interpretation of observed variables in the research model

Factor	Observed variables	Sign	Scale	Reference resources
Objective knowledge	The 4.0 industrial revolution has different names such as industry 4.0, IP industry, digital manufacturing, etc.	OK1	Likert 1-5	Merri Brucks (1985), Guido Benny (2015), Nguyen and Tran (2017)
	The industry 4.0 booms sharply in European countries.	OK2	Likert 1-5	
	The whole world participates in industry 4.0.	OK3	Likert 1-5	
	Vietnam is interested in industry 4.0	OK4	Likert 1-5	
Subjective knowledge	Industry 4.0 is a combination of technologies and breaks boundaries among the fields of physics, biology, etc.	SK1	Likert 1-5	Selnes and Gronhaug (1986), Jarut Kunanoppadol (2014), Nguyen and Tran (2017)
	Industry 4.0 is important to the Vietnamese economy.	SK2	Likert 1-5	
	Industry 4.0 focuses mostly on improving machinery and automation systems.	SK3	Likert 1-5	
	Industry 4.0 is highly competitive.	SK4	Likert 1-5	
Awareness of opportunities	Industry 4.0 makes it easier for employees to find information on job seeking.	AOO1	Likert 1-5	Brabin and Nicholls (2013), Benny (2015), Nguyen and Tran (2017)
	Industry 4.0 connects people easily and fast.	AOO2	Likert 1-5	
	Employees' income increases thanks to industry 4.0.	AOO3	Likert 1-5	
	Industry 4.0 helps enhance product quality and reduce costs.	AOO4	Likert 1-5	
Awareness of challenges	Industry 4.0 replaces the manual labor force with machines.	AOC1	Likert 1-5	Benny (2015), Nguyen and Tran (2017)
	Industry 4.0 requires significant knowledge of technology, machines, equipment, etc.	AOC2	Likert 1-5	
	Industry 4.0 increases unemployment.	AOC3	Likert 1-5	
	Industry 4.0 increases the competitiveness among employees.	AOC4	Likert 1-5	

Source: The author's proposal, 2019

III. RESEARCH METHODOLOGY

Analytical methods

To test the research hypotheses, several analytical methods are used as follows: Cronbach's Alpha coefficient to verify the reliability of the scales; Exploratory Factor Analysis (EFA) to assess the convergent and discriminant validity of observed variables; Confirmatory Factor Analysis (CFA) to evaluate the relevance of data to the market, and Structural Equation Modeling (SEM) to access the effect of the understanding about the 4.0 industrial revolution on students' awareness of opportunities and challenges.

Data collection method

To ensure the reliability in testing the appropriateness of the SEM model, the sample size from 100 to 200 is suitable [11]. According to [10], the maximum model size in SEM is 200. This study has obtained 416 observations by direct interviews, the survey audiences are seniors currently studying at both public and non-public universities in Vietnam. The universities include Can Tho University (120 seniors), Tra Vinh University (92 seniors), An Giang University (90 seniors), Cuu Long University (59 seniors), Tay Do University (55 seniors). Therefore, the sample size meets the requirements and ensures the reliability to put in testing the research hypothesis.

IV. RESEARCH RESULTS AND DISCUSSIONS

Assess the reliability of the scales

To assess the impact of understanding about the 4.0 industrial revolution on students’ perceptions of opportunities and challenges, the study used SPSS 20.0 and AMOS 22 software to support the analysis. The step-by-step result is presented as follows:

Step 1: Evaluate the scales’ reliability

The study uses the Cronbach’s Alpha coefficient to assess the reliability of the scales and to check the level of

tightness among observed variables. The testing result shows that the scales ensure reliability with Cronbach's Alpha coefficient greater than 0.6 The smallest is the “Awareness of challenges” scale (0.774) and the highest one is the “Awareness of opportunities” scale (0.894) [13], [14]. Besides, the "item-total correlation” coefficients of variables are all greater than 0.3 (minimum is 0.555) so there is no variable excluded from the research model [18], [8]. Therefore, all observations meet the requirement and will be used for the EFA step.

Table2: Cronbach’s Alpha test result

No.	Cales	Number of observations	Cronbach’s Alpha	Minimum item-total correlation
1	Objective knowledge	4	0.853	0.672
2	Subjective knowledge	4	0.824	0.623
3	Awareness of opportunities	4	0.894	0.741
4	Awareness of challenges	4	0.774	0.555

Source: Survey data, 2019

Step 2: Conduct the Exploratory Factors Analysis (EFA)

To assess the suitability of the data, the study used the Principal Axis Factoring method with Promax rotation in EFA analyzing. The analytical results are guaranteed as follows: (1) Reliability of the scale (Factor loading > 0.5); (2) Testing the suitability of

the model ($0.5 < KMO = 0.892 < 1$); (3) Bartlett’s test of the correlation between observed variables ($Sig. = 0.00 < 0.05$); (4) Cumulative of variance ($68.08\% > 50\%$). Therefore, 4 factors are formed from 16 observed variables, no variable disturbance so the names of factors remain the same.

Table3: Factors formed from the exploratory factor analysis

Sign	Observed variables	Factors’ names
F1	4 observations: OK1, OK2, OK3, OK4	Objective knowledge
F2	4 observations: SK1, SK2, SK3, SK4	Subjective knowledge
F3	4 observations: AOO1, AOO2, AOO3, AOO3	Awareness of opportunities
F4	4 observations: AOC1, AOC2, AOC3, AOC4	Awareness of challenges

Source: Survey data, 2019

Step 3: Confirmatory Factor Analysis (CFA)

After EFA analysis, 4 factors were further included in CFA. The analytical results presents the conditions are guaranteed as follows: Chi-square/df = $1.539 < 2$ [4], with $P = 0.000 \leq 0, 05$; The GFI, TLI, CFI values are 0.957; 0.979; and 0.982 respectively and all are > 0.9 [1]; RMSEA = $0.04 < 0.08$ [19]. This proves that the model is suitable for market data. In addition to this, correlations between variables are < 1 , so the model achieves the unidirectional. The standardized regression weights of scales are all > 0.5 and the

regressionweights are statistically significant, so the model reaches the convergent validity. Also, the correlation coefficientand standard deviations are < 0.9 , so the research concepts reach the discriminant validity.

Based on Table 4, the values of Pc and Pvc are satisfied. Particularly the Pvc of “Awareness of challenges” factor is < 0.5 ; but, the Pvc can still accept the value can be at 0.4 or higher under the condition that Pc is greater than 0.6 [6]. Thus, all scales in the model meet the reliability requirements, so they are used for the SEM step.

Table 4: Results of evaluating the reliability of scales

Scales	Number of observations	Composite Reliability – Pc	Average Variance Extracted – Pvc	Value
Objective knowledge	4	0.85	0.59	Valid
Subjective knowledge	4	0.72	0.56	
Awareness of opportunities	4	0.82	0.54	
Awareness of challenges	4	0.77	0.46	

Source: Survey data, 2019

Testing the research model and hypotheses

The Structural Equation Modeling (SEM) is used to test the research hypotheses. The analytical result is presented as follows:

Table 5: Testing the relationships among factors in the model

Relationship			Unstandardized			Standardized regression weight	P-value
			Estimated value	S.E.	C.R.		
SK	<---	OK	0.369	0.049	7.600	0.466	***
AOO	<---	SK	0.692	0.075	9.218	0.559	***
AOC	<---	SK	0.557	0.062	8.988	0.652	***

Source: Survey data, 2019

Based on Table 5, students' objective knowledge positively affects their subjective knowledge about the 4.0 industrial revolution, thereby leading to a beneficial impact on their awareness of opportunities and challenges from the 4.0 industrial revolution. Thus, if students have a deep understanding of the industrial 4.0 revolution, they will become aware of future opportunities to take advantage of these opportunities; also, they may overcome the challenges. The above findings help suggest some action programs for universities in the process of training and managing well-qualified human resources in the industry 4.0 era.

V. CONCLUSION AND RECOMMENDATIONS

The study pointed out the impact of students' understanding of the 4.0 industrial revolution on their awareness of future opportunities and challenges. The research results demonstrate that objective knowledge plays a very crucial role and promotes students' subjective knowledge about the impact of the 4.0 industrial revolution; thereby helping students become aware of the opportunities and challenges that the industrial revolution brings. Therefore, some recommendations are proposed as follows:

Firstly, widely raise awareness of the 4.0 industrial revolution's opportunities and challenges for students. The information related to industry 4.0 should be provided regularly and extensively throughout the universities. The information can be included in major events, communication activities, or student union's extra-curricular. Moreover, there can be periodic seminars about the 4.0 industrial revolution for students.

Secondly, include the knowledge and updated information about the 4.0 industrial revolution into the curricular taught at universities. The university management board needs to encourage lecturers to apply advanced technology in teaching and combine the knowledge about industry 4.0 together with lectures. Teachers should update the news about modern technologies all over the world.

Thirdly, organize scientific "playgrounds" for students to innovate their creativity and capacity in adapting to the 4.0 industrial revolution. Universities should develop support programs for science research among students and teachers. Besides, contests related to industrial innovation and technological applications should be taken into consideration

to help students improve their adaptability towards the 4.0 industrial revolution.

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