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Industrial Revolution 4.0: Are Students Ready for Education 4.0?

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Abstract
Purpose: This research aimed to examine the relationship between students' self-efficacy and students' readiness for Education 4.0.
Design/methodology/approach: This quantitative study was designed based on Self-efficacy theory (SET), a subset of Bandura's social cognitive theory. A validated digital questionnaire was distributed to public and private higher education institutions in Malaysia. 386 qualified questionnaires were collected. Descriptive statistics, correlation and multiple regression were used to analyse the data.
Findings: Empirical evidence indicates students in Malaysia are ready for Education 4.0 with mean score 3.724 (SD = .570). Students' self-efficacy is statistically significant in explaining the students' readiness for Education 4.0. Students' performance attainment, verbal persuasion, vicarious experiences, and physiological states show a positive effect on students' readiness for Education 4.0.
Originality/value: To the authors' knowledge, despite much research about Education 4.0 being conducted in Malaysia, little work is done on a national scale. Thus, there is a need to provide empirical evidence of the overall Malaysian tertiary students' readiness for Education 4.0 especially in the COVID-19 pandemic timeline.
Paper type: Research paper

Keywords: Industrial Revolution 4.0, Self-efficacy, Student readiness, Education 4.0, Higher education institutions

Introduction

The COVID-19 pandemic has changed how we live globally. The pandemic forced us to take an unexpected digital leap in our everyday life and practices. Many organisations have to adopt the new way of remote working using new digital systems for communication (Carroll & Conboy, 2020). Ratten and Jones (2020) stated that COVID-19 pandemic brought new challenges in the education sector. In addition, educational practices have changed, institutions are temporarily forced to close physically and engaged with online platforms (Hussein *et al.*, 2020). Now in this era of Industry Revolution 4.0 which was introduced by the German government in 2011, some higher education institutions are still not ready due to limitation in finance, infrastructure and facilities (Oyedotun, 2020).

As the COVID-19 pandemic spreads, delivery in education has gone through a pedagogical shift in the approach of teaching-learning; the education sector is fast forwarded in the adaptation of Education 4.0. With the sudden change in classes commencement, students are

required to be independent, active, innovative, and self-directed in online learning (Aguilera-Hermida, 2020). However, students' readiness and their motivation are questionable. So, this study focuses on applying one of the motivation theories, self-efficacy, to study the readiness of students toward Education 4.0. Self-efficacy is defined as beliefs in one's capabilities to organise and execute courses of action required to produce given attainments (Bandura, 1997). Many studies were conducted on self-efficacy (Bayır & Aylaz, 2020; Hakyemez & Mardikyan, 2020; Cheng *et al.*, 2020) and students' readiness (Prabowo *et al.*, 2020; Reddy *et al.*, 2020; Widodo *et al.*, 2020). However, to the best knowledge of the researchers, less paper was found on assessing students' self-efficacy and readiness for Education 4.0 in the timeline of COVID-19 pandemic especially in the whole Malaysia context. Thus, this study aims to review from the students' perspective of their perceived self-efficacy, either knowingly or unknowingly in an independent, active, innovative, and self-directed learning style. The objective of this study is to examine the relationship between students' self-efficacy and students' readiness for Education 4.0.

This study contributes to the body of knowledge of motivational studies especially students' readiness in the era of Education 4.0 during the COVID-19 pandemic. In addition, it will provide an understanding of the practicality of self-efficacy and students' readiness to serve as a helpful source of reference especially for institutions' management to understand the readiness of learners towards Education 4.0. While relating the practicality between theories and implementation, this study will also review the impact of this theoretical model in education industry which has not been practiced completely. The results of this study contribute to academia and the education industry in the future.

Literature Review and Hypotheses

Enormous socio-economic changes took place in the late 18th century which were collectively known as the Industrial Revolution (Mohajan, 2019). Industrial Revolution evolved over the years through mechanisation, electrification, and automation. Industry 4.0 is a national strategic initiative from the German government to drive digital manufacturing forward by increasing digitisation and the interconnection of products, business models, and value chains in the year 2011. It serves as the hybrid for the fourth industrial revolution, and it emphasises the development of virtual reality technology without using a large source of manpower which affects various facets of life (Devi *et al.*, 2020).

Industry 4.0 focuses on nine pillars – Additive Manufacturing, Augmented Reality, Autonomous Systems, Big Data, Cloud Computing, Cyber Security, Internet of Things, Simulation, and Systems Integration to enhance the transformation of manufacturing industries (Moreira, 2019). Boyes *et al.* (2018) stated that Industry 4.0 aims to increase the efficiency, productivity, transparency, and safety.

With the rise of Industry 4.0, all industries are impacted in every perspective including education industry. This new paradigm reinterprets the concepts of learning, student, teacher, and school according to the needs of Industry 4.0 (Himmetoğlu *et al.*, 2020). Industry 4.0 demands more from the current education system in integrating human and technology, it opens the door for new possibilities (Hussin, 2018).

Education 4.0 is a technology-based education system with the aim to improve the digital technological competencies across all levels. Besides, it provides empowerment to students in structuring their learning styles and pace. Education 4.0 functions in four ways: basic digital education for all pupils and students, digitally competent educators, digital educational media and learners and employees (Hariharasudan & Kot, 2018).

Dhawan (2020) emphasised that online learning is not an option but a necessity today. In addition, Fisk (2019 in Ishak & Mansor 2020) listed nine learning trends in Education 4.0

namely data interpretation, diverse time and place of learning, examination change, field experience, free choice, mentoring programs, personalised learning, project-based learning, and student ownership.

Data interpretation requires students to apply theoretical knowledge to numbers and using human reasoning to infer logic and trends from data (Jewell *et al.*, 2020). Diverse time and place of learning allow students to have self-paced learning as online learning tools provide opportunities to learn at different times and places. Singh and Thurman (2019) supported online learning allows students to learn flexibly. Examination changes refer to the student's performance is best measured during their learning process; the application of their knowledge is best tested with field projects. Fukuda et al. (2020) findings pointed out a strong and positive correlation between assessment and self-regulated learning skills.

Field experience emphasised within courses means institutions will give more rooms to students with hands-on experience in field studies (Madry & Pelton, 2020). Aguayo *et al.* (2020) explained free choice implies students will learn with different devices, different programs, and techniques based on their preference to fit individual characteristics and needs. Mentoring programs will become fundamental to student success. Lecturer plays a vital role as an instructor or facilitator in guiding students through the learning process, which increases confidence (Tuomikoski *et al.*, 2020).

Personalised learning means students will learn with study tools suitable with their capabilities. This implies above-average students shall be challenged with challenging tasks while others will get the opportunity to practice more. With that, it creates positive learning culture and is reflected in individual student's performance (Walkington & Bernacki, 2020).

Project-based learning is to enhance students' participation and motivation towards self-directed learning (Nainggolan *et al.* 2020, p. 897), thus, students must learn to apply skills in shorter terms to overcome different challenges. Students' ownership refers to the involvement of students in curricula design. It means an educational program that is contemporary, forward-thinking and helpful, is just practical when students are involved thus it will gain graduate attributes that maximise their employability, as supported by Bell (2016).

According to Bandura (1986), self-efficacy theory hypothesises people who view themselves as incompetent may thusly stay away from the task, while individuals who accept that they are competent would promptly perform. In this study, self-efficacy is defined along Bandura's (2006) "perceived self-efficacy is concerned with people's beliefs in their ability to influence events that affect their lives". There are four major sources of self-efficacy: past performance, vicarious experience, verbal persuasion, and emotional cues (Unrau *et al.*, 2018). Self-efficacy convictions are simply the result of an intricate conviction measure, which depends on the psychological handling expressed plainly, socially, and physiologically (Bandura, 1997). Self-efficacy impacts a person in deciding on the moves to accomplish the objectives including assessing the occasions to be confronted (Rafiola *et al.*, 2020). Successful experiences are crucial to gaining competence. Through indirect experiences, people can strengthen their belief to overcome a challenge by observing the performance of others (Cansoy *et al.*, 2020).

Performance attainment is based on individual past successful experience (Bandura, 1977). Strong efficacy expectations are developed through repeated success. Indeed, random failures might occur, however, one self-motivated persistence could be strengthened by overcoming challenges. Vicarious experiences resulting from seeing people complete threatening tasks with no negative effects may lead individuals to believe that if they persevere, they could succeed as well (Bandura, 1977). Verbal persuasion is the utilisation of empowering words that assists a person to achieve assignments viably (Suprapto, 2020). Tense or easing circumstances that are identified with mental conditions can increase or lessen people's assumptions regarding achievement or disappointment. Mostly, positive emotions increase belief in competency (Butt

et al., 2020). Physiological and affective states offer information on physiological and affective arousal in situations where the domain's capacity is shown. Uncertainty in challenging settings lowers self-efficacy beliefs (Bandura, 1977).

This study confirms despite much research about Education 4.0 being conducted in Malaysia, little work is done on a national scale. Thus, there is a need to provide empirical evidence of the overall Malaysian tertiary students' readiness for Education 4.0 especially in the COVID-19 pandemic timeline. Students' self-efficacy components can be regarded as motivational drivers for the Education 4.0 implementation programmes to succeed. All of them are intended to brace education leaders, teachers, professors, and researchers in the disciplines of Higher Education policy, leadership, student affairs, educational leadership, culture, and society.

Bandura (1997) further explains that many aspects of behaviour, including the choice of a course of action, and the emotional reaction to a successful endeavour, are influenced by self-efficacy beliefs. Self-efficacy beliefs have been empirically proven as significant behavioural predictors (Hornstra *et al.*, 2016).

We thus hypothesise:

H_1: Performance attainments positively affect students' readiness for Education 4.0.
H_2: Vicarious experiences positively affect students' readiness for Education 4.0.
H_3: Verbal Persuasion positively affects students' readiness for Education 4.0.
H_4: Physiological states positively affect students' readiness for Education 4.0.

As the self-efficacy theory is dealing with personal beliefs, it could complement the students' readiness that primarily deals with Education 4.0. For this reason, the self-efficacy theory is being integrated with students' readiness in this study.

The following is the conceptual framework of this study:

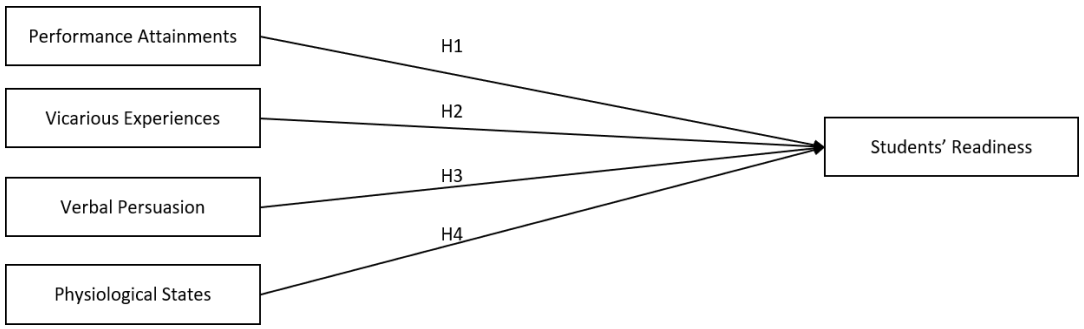

Figure 1: Conceptual Framework

Methods

A quantitative research method was used in this study which examined the application of motivation theory, especially self-efficacy for students' readiness in the era of Education 4.0. A variety of scales were adopted to collect data consisting of the self-efficacy scale (Bandura, 1986; Unrau *et al.*, 2018) and the students' readiness scale introduced by Fisk (2019 in Ishak & Mansor, 2020). All the measures of performance attainments (four items), vicarious experience (four items), verbal persuasion (four items), physiological states (three items) and students' readiness (nine items) were measured using five-point Likert scales, whereby 1 = Strongly disagree, and 5 = Strongly agree. The reliability of the questionnaire was estimated by Cronbach alpha: reliability coefficient for all the variables ranged from .85 to .93.

Digital questionnaire forms were designed and distributed via email and social media among tertiary students in both public and private higher learning institutions in Malaysia. The data

was gathered between November to December 2020. A total of 405 completed questionnaires were returned and 386 questionnaires were qualified.

To test the hypotheses, IBM SPSS version 26 was used to perform the significance testing (Brown & Saunders, 2008). A statistically significant test result with a p-value ≤ .05 suggests the null hypothesis could be rejected. To evaluate the relationship between variables, the Pearson correlation coefficient (r) is used which shows the relationship's direction and the magnitude (Hair *et al.*, 2002).

Data Analysis

A total of 386 data is analysed and the demographic background of the respondents is presented in Table 1.

Table 1: Socio-demographic Information of 386 Respondents

	Frequency	**Percentage**
Gender		
Male	132	34.2
Female	254	65.8
Age		
17 and below	2	.5
18 - 20	183	47.4
21 - 23	191	49.5
24 - 26	7	1.8
27 and above	3	.8
Type of Institution		
Public (IPTA)	222	57.5
Private (IPTS)	164	42.5
Level of studies		
Ph.D	1	.3
Master	1	.3
PostDiploma	4	1.0
Degree	222	57.5
AdvDiploma	1	.3
Diploma	149	38.6
Certificate	3	.8
Matriculation / Foundation	5	1.3

Majority of the respondents were from the age group of 18 to 23 (96.9 percentage), female (65.8 percent), and public institution were more than private institution (57.5 percent versus 42.5 percent). In terms of the level of studies, majority were pursuing degree (57.5 percent), followed by diploma (38.6 percent).

For internal reliability, the Cronbach's alpha for performance attainments was .761, vicarious experience was .844, verbal persuasion was .816, physiological states was .825, and students' readiness was .871. All the Cronbach's alpha in this study were all within the range of .65 to .95, the constructs were deemed to have satisfied the reliability test according to Chua (2013, p. 147).

A principal component analysis (PCA) was run on the four constructs (dependent variables) consisting of 15 questions in the questionnaire. All the tests indicated the suitability of using PCA. Four components had eigenvalue more than 1 explained a cumulative of 66.8% variances. A Varimax orthogonal rotation exhibited 'simple structure' showing the data was

consistent with the questionnaires' design: vicarious experiences, verbal persuasion, physiological states, and performance attainments were loaded according to their components. The descriptive statistics of each item used to measure students' readiness is presented in Table 2.

Table 2: Descriptive Statistics of Items Measuring Students' Readiness

Items	Mean	S.D.	Rank
Data interpretation	3.637	.833	6
Diverse Time and place	3.723	.821	4
Examination change	3.694	.840	5
Field experience	3.762	.786	3
Free choice	3.935	.792	1
Mentoring	3.619	.842	7
Personalised learning	3.798	.763	2
Project-based learning	3.798	.787	2
Students' Ownership	3.552	.852	8

The results of Pearson correlation are presented in Table 3. Performance attainment, vicarious experience, verbal persuasion, and physiological states were found to be statistically significant in the prediction that each has a positive effect on students' readiness.

Table 3: Results of Pearson Correlation

	Mean	S.D.	Correlation coefficient, r	t-statistics	p-value
Performance attainment	3.688	.588	.655	16.979	<.001
Vicarious experience	3.936	.672	.403	8.633	<.001
Verbal persuasion	3.459	.683	.498	11.242	<.001
Physiological state	3.527	.796	.547	12.808	<.001

A multiple regression analysis is used to identify the strength of each variable in predicting the students' readiness. The data was checked for fulfilment of the various assumptions including normal distribution of residuals, homoscedasticity, independence of residuals (Durbin-Watson 1.938) and multicollinearity. None of the Tolerance value is less than .01 indicating no issue of collinearity. The regression results are displayed in Table 4.

Discussion

The goal of this study was to explore the relationship between students' self-efficacy and students' readiness in Education 4.0. Self-efficacy beliefs about students' self-perceived ability to fit into the industrial revolution 4.0 paradigm. Based on the findings, the study concluded that the tertiary students in Malaysia are ready for Education 4.0. Students are ready to learn at different times and places, personalised learning according to their capabilities, able to modify their learning process with different tools or programme that they feel necessary, to obtain real-world skills that are representative to their future jobs, applying the theoretical knowledge to numbers, and using human reasoning to infer logic and trends. They also show readiness for the changes in the curriculum assessment methods and would like to involve in creating their

curriculum. Last but not least, they are ready to be more student-centred in the learning process and understanding the role of the lecturer as a facilitator. The findings in Table 2 shows students' ownership ranks the lowest amongst the nine trends in Education 4.0. This indicates the students are either less active or not given the opportunity to participate in forming their curricula. Besides, education institutions might neglect the importance of the students' involvement in the effort of maintaining contemporary curricula. Critical input from students on the content and durability of their courses is a must for an all-embracing study program.

Table 4: Regression Results

Variables	**Beta coefficient**	**Standard Error**	**t-statistics**	**p-value**	**Tolerance**	**VIF**
Constant	.735	.152	4.830**	<.001		
Performance attainment	.406	.044	9.256**	<.001	.599	1.668
Vicarious experiences	.143	.032	4.415**	<.001	.844	1.185
Verbal persuasion	.063	.037	1.687	.092	.615	1.627
Physiological states	.203	.030	6.823**	<.001	.711	1.407

Significance at: **p<.001; R^2 = .534, adjusted R^2 = .529; dependent variable: Students' readiness.

The findings showed that performance attainment, vicarious experiences, verbal persuasion and physiological states each had a significant and positive relationship with the students' readiness for Education 4.0. Individual mastery experience is used to determine performance (Bandura, 1977). Repeated success and achievement in education build strong efficacy expectations. Students' readiness for Education 4.0 may achieve as well if they have vicarious experiences coming from witnessing peers achieving good results or outcomes (Bandura, 1977). Compliments from the significant ones like lecturers, peers or parents aid students' self-efficacy in Education 4.0 (Suprapto, 2020). Positive emotions definitely boost confidence in students' self-efficacy (Butt *et al.,* 2020). In circumstances where the students' capability is demonstrated, physiological and emotional states provide information about physiological and affective arousal. Students continue to interpret the physical experience as a sign of belief in effortless situations, increasing self-efficacy (Bandura, 1977).

Performance attainment, verbal persuasion and physiological state have a significant moderate relationship with students' readiness for Education 4.0, while vicarious experiences have a weak positive relationship. Although Kudo *et al.* (2015) finds that vicarious experience to be the most instant and direct effect on an individual's self-efficacy, this study suggests the contrary which is consistent with the study of Hamdan *et al*. (2021). Students have low interaction between learner-and-learner during the COVID-19 pandemic thus their self-efficacy expectations are less influenced by vicarious experiences.

This study provided empirical evidence of the different contributing factors influencing the self-efficacy towards students' readiness for Education 4.0. To foster students' self-efficacy, the study revealed that students' performance attainment, vicarious experiences, verbal persuasion, and physiological states are predictive of students' readiness for Education 4.0. These findings are supported by the study conducted by Hamdan et al. (2021) and Sökmen (2021). Table 4 shows that adjusted R Square is .529 for multiple regression of students' readiness for Education 4.0 which means 52.9% of the variation in the students' readiness for

Education 4.0 can be explained by self-efficacy (performance attainment, vicarious experiences, verbal persuasion, and physiological states). The other 47.1% remain uninfluenced.

Theoretical, Practical and Social Implications

These findings aid in the refinement of theoretical and empirical understandings of the sources of self-efficacy and its impact on students' readiness for Education 4.0 especially in the time frame of COVID-19 pandemic. Even though results show that the Malaysia students are ready for Education 4.0, however it is still in the growth stage. To successfully implement Education 4.0, integrated supports from higher learning institutions in terms of future-ready curricula and realising digital transformation must be understood by all stakeholders especially the learners and academicians. Understanding learners' needs and involve them in the curricula planning is important for achieving current and relevant curricula (Fisk, 2019). Teachers' self-efficacy and technology proficiency are also under research (Morris *et al.*, 2017; Rupp & Becker, 2021). Academicians play a vital role in the education process. Higher education institutions also ought to encourage academicians to extend formal, informal and unformal learning through the internal knowledge management system, external and interface learning (Ishak & Mansor, 2020).

In this study, the students' motivation to be future-ready is examined in the context of students' self-efficacy. The results provide insights into students' cognitive by providing empirical evidence of the factors influencing their motivation of Education 4.0 readiness. This study will help to build a strategic plan to support students - a stakeholder in the education system, be mentally and emotionally ready for Education 4.0.

Limitations and Suggestions for Future Research

The results of this study are limited to a description of the occurrence and variables within a suggested framework. Research might overlook other possible causes for the problem which can be investigated further to determine the most likely source of the issue. This fraction of research is based on learner self-efficacy focusing on Education 4.0. Kim (2005) had noted that there is a substantial expansion of online courses signifying that Online-Courses-Self-Efficacy is an aspect to consider for academic self-efficacy.

Another limitation arises from the sampling segmentation. Even though a good sample size is obtained, students are not being grouped according to the diverse background such as field of study and course. Fisk (2019) suggested nine dominant skills required for Education 4.0, however, each discipline might weigh these skills differently. As such, the finding might not generalised.

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