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Exploring Factors for Teachers' Perceptions towards Virtual Learning during COVID-19 Pandemic Era from the Perspective of Diffusion Innovation Theory

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Abstract
Purpose: This paper aims to validate the items in the teachers' perception towards virtual learning in current situation of pandemic COVID-19 outbreak. This paper adopts Diffusion Innovation Theory that was introduced by Rogers 1995. According to the previous studies, this theory is one of the most appropriate theory in investigating the adoption of technology and innovation in education system especially in higher education.
Design/methodology/approach: As this aims to validate the items in all the five components, authors have employed reliability testing, Exploratory Factor Analysis (EFA), and Cronbach's Alpha testing by using Statistical Package for Social Sciences (SPSS) software version 24.0 in analysing the results. In measuring all the five attributes, the data has been obtained through the survey among the selected sample.
Findings: There are 33 items in total for this study. After conducting the KMO, it resulted in a value of 0.939 which exceeded the recommended value, therefore it indicates that the sample is adequate to test the factor analysis. In addition, all these five factors showed a consistent internal consistency value range, indicating the reliability values are very good and sufficiently high. Hence, no item was being removed and this instrument is valid and reliable to be used/for usage in future studies involving teachers' perception towards virtual learning.
Research limitations/implications: This study faced difficulty to obtain more response from the targeted population and it may somewhat reduce the generalisability of the result. Hence, the results of this study may not represent the voice of all teachers in Malaysia, therefore further research regarding teachers' perception should be conducted with greater number of sample.
Practical implications: Better perception and adoption of innovation in education system were hoped to ensure uninterrupted learning process and will achieve the proposed SDG4.
Originality/value: The research is anticipated to provide a new teachers' perspective towards innovation during the pandemic crisis.
Paper type: Research paper

Keywords: Virtual learning, Teachers' perception, COVID-19, Pandemic, Diffusion innovation theory, Exploratory factor analysis

Introduction

Year 2020 started with the usual activities in Malaysia; parents were still going to work, educators were starting school session with preparing materials for teaching and learning process, and children were looking ahead to learn at school and for school holiday. However, the Coronavirus Disease 2019 (COVID-19) pandemic happened and turned everything upside down. Routines changed and every single individual in Malaysia needed to adapt with the changes. The outbreak of COVID-19 not only caused health crises around the world, but it also affected all aspects of life, including education (Lapada, Miguel, Robledo & Alam, 2020).

According to a report from UNESCO (2020), the COVID-19 pandemic has caused the largest disruption to the education system in history. Over 1.57 billion students, representing over 90% of the population in more than 190 countries were affected. Consequently, teaching and learning style quickly needed to be switched to online learning using mix of technologies, different from the traditional face-to-face learning. Indirectly, it indicates that virtual learning has become necessary for students and teachers all over the world including in Malaysia as the government introduced a MCO after the outbreak was declared a pandemic on 11 March 2020 and also to prevent students from contracting the harmful virus.

Historically, even during the H1N1 and SARS outbreaks, several nations like Malaysia have never seen such a disruption in the educational line (Adnan & Anwar, 2020). Thus, it has become the new norm with more flexible teaching and learning processes. Students and educators must become familiar with the online methods and adjust to the new standard. Educators will be inspired to explore new online platforms and participate more in online classes and activities if they embrace these developments but doing so comes with its own set of hurdles (Sawal, 2020). Virtual learning systems, often known as online learning systems, are web-based tools for distributing, tracking, and managing online courses. By using advances in technology, it is possible to better control how educational materials are designed and delivered while also facilitating communication between students and teachers who may be in different places.

Virtual learning is not a new concept; it was made possible because of the tremendous advancements in technology at the time it was developed. Learning environments have seen significant changes as information and communication technology have extended widely, opening the door to new types of environments (Duan, He, Feng, Li & Fu, 2010). It is indeed has provided everyone in the education sector huge opportunities to experiment with and come up with innovative approaches to the educational system. Plus, it has been widely used in higher education prior to COVID-19, however it was optional during that time. During the wake of the pandemic, this way of learning is the only- option that we have as we are not allowed to have any face-to-face classes and virtual learning needed to be enforced immediately to ensure the continuity of the education.

Virtual learning becomes a particular challenge for some especially in the situation of emergency which is a prompt shift from traditional concept of learning to virtual teaching (Hodges, Moore, Lockee, Trust & Bond, 2020). Most educators have been thrown into virtual learning for which neither they themselves nor their condition were well prepared. However, it is kind of an immediate solution for all teachers and students worldwide including Malaysia. Even though this new norm in learning is different in implementation, but the initiative taken is anticipated to achieve the goals of; curbing the spread of disease and to ensure an uninterrupted learning that will indirectly reduce inequality of access to education. This is in line with the Sustainability Development Goals 4 (SDG 4), Quality Education which intent to protect the well-being of children and ensure they have access to continue learning during this pandemic era. According to Ghavifekr, Kunjappan and Ramasamy. (2016), integrating technology into teaching and learning process is a dynamic process that may face a variety of

difficulties. Furthermore, virtual learning requires adequate time, readiness and preparations in ensuring better experience and successfulness of virtual learning classes, otherwise it will affect the teaching and learning process (Mohd Salleh & Nik Azman, 2020). As per survey done by OECD (2020) found that educators have reported high need for training in the use of Information and Communications Technology (ICT) in their teaching and learning process because virtual learning is an innovative concept of using emerging ICT equipment (Duan et al., 2010).

Previous researches have paid attention to teachers' perception towards online learning in the context of the COVID-19 pandemic (Rahayu & Wirza, 2020; Tarihorana, Syafurib & Masykur, 2021; Nashir & Roudlotun 2021). However, there is no studies that discussed teachers' perception toward online learning in terms of coping with technology and innovation adoption during this critical transition phase. According to Sahin (2006) and Medlin (2001), Rogers' diffusion of innovations theory is the most appropriate theory in investigating the adoption of technology in education system especially in higher education. Hence, this study is adopting the diffusion of innovation theory by Rogers (1995) to discover the educators' perception towards online learning during COVID-19 era. Rogers (1995) has identified five attributes in this theory to study on the influences of people to adopt or diffuse certain changes in life namely perceived relative advantage, perceived compatibility, perceived complexity, perceived trialability and perceived observability. From this context, this paper's central aim is to validate the items in the teachers' perception towards virtual learning.

Diffusion Innovation Theory

Researchers have been looking into how new innovations are adopted for decades. Rogers' theory is a commonly used in the field of technology diffusion and adoption and was introduced in 1995 (Sahin, 2006). According to Raman et al. (2021), Rogers' Diffusion of Innovation Theory accommodates a wider range of innovation characteristics than previous theories. Rogers (1995) identified found that relative advantage, compatibility, complexity, trialability, and observability are the five most important aspects of an innovation when it comes to acceptance and diffusion. In this study, it can be translated that for a faster rate of diffusion, a teacher must perceive that the innovation in current education system:

i) Has a relative advantage
ii) Is compatible with previous practices and values
iii) Is not very complex to be implemented
iv) Can be tried prior to the adoption
v) Offers observable results of implementation

Perceived Relative Advantage

It is referring to the degree to which a person believes that the new invention outperforms the existing one (Duan et al., 2010). According to Rogers (1995), it is important for a person to perceive the innovation ‘‘to be advantageous" by measuring their ‘‘economic terms, social prestige, convenience and satisfaction". Studies by Mohamad Hsbollah and Md Idris (2009), Mehrtens, Cragg and Mills, (2001) and Premkumar and Robert (1999) indicated that people's perceptions of relative benefits become an important component that drives participation in adopting new technology. A person's willingness to adopt new technology is influenced by such factors. Consequently, it may be predicted that the faster an invention's adoption rate is, the greater the perceived relative advantage of that innovation during the pandemic era.

Perceived Compatibility

According to Rogers (2003), "compatibility" is referred to as the degree to which an innovation is viewed as consistent with current values, prior experiences, and requirements of potential adopters, and it is linked to attitudes of individuals. It is more likely that innovation is suitable to be adopted when it is compatible with individuals (Rogers, 1995). Relative advantage and compatibility have been compared in the past, but they are conceptually distinct concepts. If a teacher feels that a new manner of teaching and learning during a pandemic is in line with their present values and philosophy of teaching, they are considered compatible (Mohamad Hsbollah & Md Idris, 2009). According to Sahin (2006), teachers' attitudes on teaching are influenced by innovation. Uncertainty will lessen and acceptance of the innovation will grow if it is compatible with an individual's demands. They'll have a favorable impression of the innovation in the background because of it. The association between compatibility and adoption was also acknowledged by Premkumar and Robert (1999) and Martins et al. (2004). Raman et al. (2021) and Duan et al., (2010) discovered that perceived compatibility was associated with their variables in a positive manner.

Perceived Complexity

Some people find the innovation uncomplicated to use and easy to understand, while others see it as a new level of information that they may find challenging to use and comprehend (Zhang, Wen, Li Fu & Cui, 2010). According to Rogers (2003), complexity is "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 15). According to Roger, complexity has a negative correlation with adoption rates when compared to the other four qualities. Mohamad Hsbollah and Md Idris (2009) stated if lecturers are less likely to adopt innovations if they regard them as complex and difficult to adopt. As a result, the innovation would spread more slowly and with a smaller impact. If they didn't innovate, they wouldn't be able to get the full benefits either. While, according to Duan et al. (2010) complexity had no major impact on their findings. Being an innovation for nearly all teachers during the pandemic era, virtual learning adds some complexity to the implementation because it is a sudden change in the teaching and learning system. As a result, in the COVID-19 epidemic period, the adoption of new innovations can be hampered by the intricacy of the new ideas, which can lead to a negative public view of the new virtual learning methods.

Perceived Trialability

"Trialability is the degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003, p. 16). A potential adopter's ability to perceive an innovation will improve as they try it out more often, which will lead to a faster adoption rate. Rogers (1995), asserts that people who are given the opportunity to try out a new idea are more likely to adopt it. Trialability also offers the adopter the chance to assess the benefits of innovation (Saleh Zolait & Sulaiman, 2008). In turn, some people's apprehension about the new technology will subside. According to Raman (2021) and Mohamad Hsbollah & Md Idris (2009) e-learning adoption is favourably correlated with trialability. In the meantime, Duan et al. (2010) discovered in their research that perceived trialability has a detrimental impact. It's a critical part of the present educational system because all teachers must use new technology and innovation in the way they teach. Trialability is used in this research to describe the ability of a teacher to experiment with new technology and innovations before implementing them in their lessons. According to Martins et al. (2004), trialability was the most important factor in determining whether or not novel teaching methods will be adopted.

Perceived Observability

Observability of an innovation refers to the level of which ‘‘the results of the innovation are visible to others” (Rogers, 1995 p. 16). According to Rogers (2003), the adopter is more likely to adopt the innovation when they are visibly observing those result and convey the benefits. The ease with which people may watch, conceive, or explain new technology according to Bennett and Bennett (2003) was termed as observability. According to Roger, an innovation's trialability and observability can help it gain traction with early adopters. However, according to Duan et al. (2010), observability has no effect on e-learning take-up intentions and plays no role in shaping it. Raman et al. (2021) and Martins et al. (2004), on the other hand, discovered that observability was closely linked to students' use of the internet as a learning resource. They discovered that an innovation's observability is a strong predictor of its adoption. Teachers are likely to have a better perspective of virtual learning if they can see the new method being applied successfully, which is the goal of this study.

Methodology

A cross-sectional survey was employed via online survey and SPSS version 24 was used in analysing the data. The data collected were purely quantitative coming from teachers who are required to teach online during the pandemic.

Respondent Profile

A total of 36 teachers in Muadzam Shah, Pahang, participated in this survey. Respondents consisted of 32 females and 4 males, and the highest number of respondents are aged between 31-40 years old. In terms of teaching experience, majority of the respondents have 5-10 years of working experience. In terms of marital status, most of the respondents are married, with household annual income of more than RM 60,000.

Instrument Development

This study developed a questionnaire from an extant research on the Diffusion Innovation Theory by Rogers (1995). Even though the provision of virtual learning can be different in terms of platforms and application contexts, the innovative concept remains the same. Innovation was described as: “An idea, practice, or project that is perceived as new by an individual or other unit of adoption” (Rogers, 2003, p. 12). An innovation has been invented a long time ago, however if individuals perceived it as new, then it is an innovation for them. According to Sahin (2006) and Medlin (2001), Rogers’ diffusion of innovations theory is the most appropriate theory in investigating the adoption of technology in education system especially in higher education. Due to no specific research in identifying teachers’ perception towards virtual learning in this pandemic era in the context of innovation adoption, this study is adopting the diffusion of innovation theory to discover teachers’ perception towards online learning during COVID-19 era, as the teaching and learning process is currently solely conducted through online. All the ICT equipment, facilities and innovation were believed to be adopted in delivering the mission of teaching and learning by all the teachers.

The instrument in this study was divided into two parts. Part I consisted of questions that aimed to obtain background information of all respondents. Subsequently, Part II is a five-point Likert scale questionnaire that will be the main focus in evaluating teachers’ perception towards the online learning in current pandemic situation. This part consisted of 33 items in total from all the five construct namely relative advantage, compatibility, complexity, trialability and observability. The developed instrument is based on the Rogers (1995), Martins, Steil and Todesco (2004) and Duan et al. (2010). The structured questionnaire was distributed among respondents via Google form.

Procedure for Model Assessment and Statistical Analysis

In order to address the research question, reliability testing, EFA, and Cronbach's Alpha testing were done with (SPSS) software version 24.0. There were two stages to the data analysis. A number of data screening-related issues were explored in the first step, for example handling missing data and finding outliers or normality. For the examination of normality, as indicated by Byrne and Van de Vijver (2010), the skewness value ranged from -2 to +2 and the kurtosis ranged from -7 to +7 are used for the testing of normality. As in Table 1 below, the data is normally distributed as it falls in the range. This was followed by a second round of testing using Cronbach's alpha and descriptive statistics. Cronbach's alpha was computed to determine the reliability of the instrument (total and subconstructs). Alpha values of 0.60 to 0.70, according to Hair, Black, Babin, and Anderson (2010), are considered satisfactory.

Table 1: Normality Results

Items	Skewness		Kurtosis		Items	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error		Statistic	Std. Error	Statistic	Std. Error
ADV1	0.073	.393	-1.287	.768	CLEX1	-1.163	.393	0.424	.768
ADV2	-1.838	.393	3.724	.768	CLEX2	-1.478	.393	2.474	.768
ADV3	-0.483	.393	-0.130	.768	CLEX3	-0.741	.393	0.282	.768
ADV4	-1.275	.393	1.661	.768	CLEX4	-1.986	.393	5.628	.768
ADV5	-1.730	.393	4.687	.768	CLEX5	-0.454	.393	-0.340	.768
ADV6	-0.213	.393	-0.540	.768	CLEX6	-0.008	.393	-1.248	.768
ADV7	-0.432	.393	-.466	.768	TRIL1	-1.652	.393	3.371	.768
ADV8	-1.698	.393	4.193	.768	TRIL2	-1.577	.393	2.636	.768
ADV9	-.386	.393	-0.509	.768	TRIL3	-0.185	.393	-0.955	.768
COMP1	-1.125	.393	1.092	.768	TRIL4	-0.575	.393	-0.549	.768
COMP2	0.142	.393	-1.153	.768	TRIL5	-0.900	.393	0.645	.768
COMP3	0.143	.393	-0.855	.768	TRIL6	-0.126	.393	-0.633	.768
COMP4	0.327	.393	-0.880	.768	OBSR1	-2.107	.393	7.901	.768
COMP5	0.349	.393	-0.847	.768	OBSR2	-2.426	.393	9.969	.768
COMP6	-0.889	.393	0.388	.768	OBSR3	-2.642	.393	10.673	.768
COMP7	-0.513	.393	-.482	.768	OBSR4	-1.710	.393	5.199	.768
					OBSR5	-1.166	.393	2.104	.768

Exploratory Factor Analysis (EFA)

The Kaiser–Meyer–Olkin (KMO) test and the Bartlett's test of sphericity for evaluating the factorability of the data were performed before conducting the Exploratory Factor Analysis (EFA) (Chang & Qi, 2018). As depicted in Table 2, the KMO test yielded a score of 0.939. A significant test statistic was revealed by Bartlett's test of sphericity ($p < 0.001$). This result are above the recommended of 0.600 (Kaiser, 1974), indicating that the sample was adequate to test the factor analysis.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.857
Bartlett's Test of Sphericity	Approx. Chi-Square	8058.502
	df	1225
	Sig.	0.000

There were 33 items in the EFA of teacher perceptions of virtual learning. Two methods were utilised to establish the proper number of factors for the questionnaire during the identification process. Referring to Kaiser's criteria, it indicates that researchers should focus on factors with Eigenvalues more than 1.0, which indicates that the items in the instrument contain more than one factor. Once the Oblimin rotation procedure was completed, any items with a coefficient value less than 0.3 were removed from inclusion (Hair, Black, Babin, & Anderson, 2010). There were 33 items in total with a coefficient value greater than 0.3. Based on the factor loading, no items were removed from Table 3 because none had a factor loading greater than 0.30. As indicate by Hair et al. (2010) and Pallant (2020) internal consistency is deemed good when the item loading factor exceeds 0.30, which is achieved in this study.

Table 3: Results for EFA

Variable	Item	Extraction	Variable	Item	Extraction
Perceived Relative Advantage	ADV1	.812	Perceived complexity	CLEX1	.576
	ADV2	.860		CLEX2	.721
	ADV3	.743		CLEX3	.812
	ADV4	.830		CLEX4	.595
	ADV5	.795		CLEX5	.842
	ADV6	.848		CLEX6	.721
	ADV7	.842	Perceived Trialability	TRIL1	.917
	ADV8	.700		TRIL2	.887
	ADV9	.831		TRIL3	.877
Perceived Compatibility	COMP1	.762		TRIL4	.881
	COMP2	.772		TRIL5	.943
	COMP3	.897		TRIL6	.825
	COMP4	.898	Perceived Observability	OBSR1	.856
	COMP5	.893		OBSR2	.903
	COMP6	.793		OBSR3	.831
	COMP7	.778		OBSR4	.837
				OBSR5	.822

As a result of the Oblimin rotation, the questionnaire items now appear to be five dimensional in nature (containing five factors). Variation in the projected values of five variables ranged from 35.55 percent for factor 1, to 17.10 percent for factor 2, to 6.52 percent for factor 3, to 6:31 percent for factor 4, and to 4.06 percent for factor 5. Factor 1 has nine items (ADV1-ADV9), factor 2 has seven (COMP1-COMP7), factor 3 has six (CLEX1-CLEX6), factor 4 has six (TRIL1-TRIL6), and factor 5 has five (OBSR 1-OBSR5) in the rotated component matrix. In Table 4, you'll see how the Oblimin rotation worked out in terms of results. Table 4 illustrates the result of the Oblimin rotation process. Thus, a five-factor solution confirms the five dimensions of teacher perception towards virtual learning by Rogers (1995), Martins, et al., (2004) and Duan et al., (2010).

Table 4: Results of the Oblimin rotation process

	Numbers of items	**% of Variance**
Perceived Relative Advantage	9 (ADV1-ADV9)	35.549
Perceived Compatibility	7 (COMP1-COMP7)	17.102
Perceived Complexity	6 (CLEX1-CLEX6)	11.972
Perceived Trialability	4 (TRIL1-TRIL6)	6.520

Perceived Observability	5 (OBSR 1-OBSR5).	6.311

Reliability Analysis

All five factors were supported by Cronbach's alpha reliability of 0.902. There were five Cronbach's alpha coefficient values calculated: 0.879, 0.889, 0.707, 0.871 and 0.952 for each component. All components were internally consistent and well defined, as shown by the Cronbach's Alpha values in Table 5 below, all of the values above the 0.7 criterion (DeVellis & Thorpe, 2021).

Table 5: Reliability Result

Variables	**Number of items**	**Cronbach's Alpha**
Perceived Relative Advantage	9 (ADV1-ADV9)	0.879
Perceived Compatibility	7 (COMP1-COMP7)	0.889
Perceived Complexity	6 (CLEX1-CLEX6)	0.707
Perceived Trialability	4 (TRIL1-TRIL6)	0.871
Perceived Observability	5 (OBSR 1-OBSR5)	0.952
Overall	**33**	**0.902**

Discussion

One of the main purpose of this study was to verify teachers' perceptions towards online learning as in the presence of the pandemic and as we move towards virtual learning. Thus, an instrument with 33 items was generated for five components, no item being removed. In future studies addressing teachers' perceptions of virtual learning, this tool is valid and reliable for use. Teachers' perceptions of virtual learning can be explained by the five components. The instrument created is based on Rogers (1995), Martins, et al. (2004) and Duan et al. (2010). In fact, the Cronbach's alpha values of all components are adequate. According to the results, the instrument has an overall reliability score of 0.902, with individual factor Cronbach's alpha values of 0.879, 0.889, 0.707, 0.871 and 0,952 showing a constant internal consistency value. The reliability values were both very good and sufficiently high.

Conclusion and Limitation

In adopting something new that we call an innovation, it may take some factors into consideration. This study focused on the five elements. All the five elements have been validated and the results met the recommended values. Hence, the objective of this study has been achieved. It is expected to provide a guide for future research in this same area. The results also can be used in enhancing the implementation of new teaching and learning system regardless during the outbreak of COVID-19 pandemic. All the teachers, Ministry of Education (MOE) and any involved parties need to ensure undisrupted learning, protect the well-being of children and ensure they have access to continue learning as proposed by UNESCO in SDG 4. Although this study has met its objectives, there are limitations as well. This study had a difficulty to obtain more responses from the targeted population. Hence, the results of this study may not represent the voice of all teachers in Malaysia. However, the limitation mentioned will not invalidate the findings of the study. Further research regarding teachers' perception should be conducted with greater number of sample.

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