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Impact of Social Media on Perceptions and Use of Renewable Energy Sources

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Abstract

Social media plays an important role in increasing knowledge, attitudes and acceptance of renewable energy. This study used modified EPPM and extended information adoption model to investigate the effect of social media on information adoption and use of renewable energy. The statistical population of the study includes Instagram users who have followed the pages related to solar energy. The questionnaire was randomly distributed among potential respondents using an online survey platform and 173 completed questionnaires were collected. The results of structural equations modeling (SEM) of modified EPPM showed that trust in information obtained from social media regarding renewable energy affects the perceived severity and susceptibility of the consequences of using conventional energy/fuels. Also, the results of SEM of the extended information adoption model indicate that the argument quality as a central path has a positive and direct effect on the perceived usefulness information. Also, the source credibility as a peripheral path indirectly affect perceived usefulness of information via changing attitudes toward information. In addition, based on the findings, perceived usefulness has both a direct impact on information adoption, as well as has indirect effect on information adoption via trust mediation. As both studies have shown; Trust in the source of information plays a key role in improving the impact of information on people's lifestyles. Therefore, it is necessary for environmental policymakers to use trusted media to lead people to do environmental behaviors.

Key words: Renewable Energy, Extended Parallel process model, information adoption model, trust in social media.

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Introduction

Global energy demand is projected to increase steadily due to the rapid increase in world population, income growth along with the industrialization, urbanization and motorization (Zyadin et al., 2012). For example, the International Energy Agency forecasts that 60% growth in global energy demand will increase from 4,500 billion liters of oil in 2002 to 7,700 billion liters in 2030 (De Fraiture et al., 2008). Evidence shows that energy consumption has increased worldwide and has increased 22.6 times in the last century. Most of the world's energy needs come from petrochemicals, coal and natural gas. Exception of hydropower and nuclear power, other sources of energy supply are limited and will soon run out with current consumption rates (Demirbas and Demirbas, 2007). Hence, concerns about daily fossil fuel consumption are increasing due to limited reserves and their impact on the environment (Karatepe et al., 2012).

In particular, the Middle East energy sector, including Iran, is dominated by low-cost fossil fuels. Iran has a very high per capita energy consumption (80% higher than the average consumption in the Middle East) due to high levels of energy and fuel subsidies for consumers and businesses, which leads to inefficient energy consumption. All of these factors can create economic and environmental problems for the Middle East and Iran. For example, carbon dioxide emissions in Iran, Iraq, and Saudi Arabia increased by 35.7%, 21.75%, and 15.6% from 2000 to 2010, respectively (Nematollahi et al., 2016).

Renewable energy sources (RE) can be one of the possible options for decarbonizing energy supply as well as meeting growing energy demand (Yazdanpanah et al., 2015ab). The United Nations has designated the decade 2014-2024 as the Decade of "Sustainable Energy for All" for secure access to cost-effective, reliable, sustainable and modern energy for all (Bhattacharya et al., 2016; Kumar et al., 2017). Successful transfer of sustainable energy calls for significant advances in new renewable energies, and therefore, research and development studies paint an optimistic future for the use of renewable energy sources (Karatepe et al., 2012). Sütterlin & Siegrist (2017) point out that the potential of renewable energy sources is enormous, as they can in fact go beyond (exponentially) the global energy demand.

Renewable energy can be a great answer not only in terms of energy sustainability and security but also in terms of reducing greenhouse gas emissions and economic growth (Yadoo and & Cruickshank, 2012; Baharoon et al., 2016).

To expend renewable energy, it is not enough to just implement supportive policies or remove technological and economic barriers, the main challenge is to ensure that renewable energy is accepted by end consumers (Elmustapha et al., 2018; Rezaei and Ghofranfarid, 2018; Yazdanpanah et al., 2015a). The development of renewable energy depends to a large extent on changing the voluntary behavior of consumers towards green electricity products (Esteban et al., 2012; Hartmann, 2016).

Numerous studies have identified barriers to consumer acceptance of RE, many of which have been related to lack of awareness, or lack of knowledge about environmental impacts (Parkins et al., 2017; Fung et al., 2010). Therefore, in previous studies, perception of risk and problem and environmental awareness have been described as very important factors affecting environmental acceptance and behavior (Arlt et al., 2011). There is also evidence that support for renewable energy technologies is being raised given the level of environmental concerns, especially about climate change (Qazi et al., 2019). Thus, increasing awareness of the worrying environmental consequences of CO2 and NOx and chlorofluorocarbon emissions increases interest in environmentally friendly technologies (Omer et al., 2009). Since the media are the most important platforms for providing information, arguments and discussion forums on renewable energy issues (Rochyadi-Reetz et al., 2019), it is obvious that the media have a special role in activating mental processes, increase of knowledge and attitude of individuals (Arlt et al., 2011) and the acceptance of renewable energies (Djerf-Pierre et al., 2015).

Renewable energy and its status in Iran

Renewable energy is energy from natural and repetitive currents that occur in the local environment (Twidell & Weir, 2015). Comparison of renewable energy sources (green) with conventional energy (brown) shows that the lifetime of renewable energy supply has been infinite and their cost is free, although the cost of equipment capital per kw capacity has been expensive (about 1000 $). Conventional energy resources have a limited lifetime, high cost, and average equipment capital cost (approximately $ 500 without emissions control and more than $ 1,000 with emissions reductions) (Twidell & Weir, 2015).

According to the five-year law of the Sixth Development Plan (2017-2021), the government must increase the share of renewable and clean power plants to at least five percent by the end of its implementation. Article 50 of the Sixth Development Plan Law emphasizes that the government is obliged to increase the share of renewable and clean power plants with the priority of investing in the domestic and foreign non-governmental sector with maximum use of domestic capacity by the end of the program law to at least five percent of the country's electricity capacity. In addition to energy supply, renewable energy also has the potential to reduce greenhouse gas emissions. For example, the country's renewable power plants, whose capacity has now reached 800 MW, have been able to prevent the release of 2.984 million tons of greenhouse gases (IRNA, 2020). Therefore, these types of resources will have a significant share in the global energy portfolio in the future. In this regard, Global electricity generation from renewable energy sources is projected to grow 2.7 times between 2010 and 2035 (Ellabban et al., 2014).

Although Iran is very rich in conventional (fossil) energy, it has a very high potential for large-scale use of solar energy systems, because its available in Middle Eastern countries and are more accessible than others (Mostafaeipour and Mostafaeipour, 2009). It is also predicted that the consumption of PV solar energy will increase about 26 times from 2010 to 2035 (Ellabban et al., 2014).

Solar energy generation involves the use of solar energy to supply hot water through solar heating systems or the generation of electricity through solar photovoltaic (PV) and solar energy (CSP) systems (Byrne et al., 2010). From the BP Statistical Review of World Energy, it is very glaring that the global annual energy consumption can be supplied by solar energy in every 88 minutes or about 6000 times total annual energy consumption yearly (Ohunakin et al., 2014).

Theoretical background

This study is based on two theoretical models Extended Parallel process model and information adoption model to investigate the impact of Instagram on the intention and use of renewable energy.

Extended Parallel process model

According to EPPM theory, perceived threats and perceived effectiveness can affect people's behavior. perceived threat consisted of constructs of perceived susceptibility and perceived severity and perceived effectiveness consists of two constructs of perceived self-efficacy and perceived response effectiveness (Askelson et al., 2015; Witte and Allen, 2000).

Perceived susceptibility refers to the mental dangers of being in a situation (Rosenstock, 1974) or to one's mental perception of the danger of a particular behavior. Perceived severity refers to an individual's belief in the seriousness of the consequences of such behavior (Glanz et al., 2008).

Perceived self-efficacy is defined as a personal belief in the ability to perform behaviors recommended by messages (Hart & Feldman, 2016; Askelson et al., 2015), while perceived response effectiveness refers to beliefs about the effectiveness of a recommended response to avert the threat (Chen & Yang, 2018).

According to EPPM, these four variables can affect attitudes toward renewable energy use, the intention to use renewable energy, and the use of renewable energy (Witte & Allen, 2000). In addition, according to the theory of planned behavior (TPB) (Ajzen & Fishbein, 1975), intention is the most important predictor of environmental behaviors. Intention indicates how much a person is willing to try to do the behavior (Ajzen, 1991). Also, according to TPB, the attitude towards doing a behavior affects the intention to do that.

According to study Fang et al., (2012), trust in information sources is likely to affect the perception of risk. Fang et al., (2012) point out that dis-trust of an information source leads people to underestimate the information obtained from that source and reduces the perception of risk. Hence, we extended EPPM by adding trust in social media as a source of information. It is expected that people who, after receiving messages from trusted social networks, feel a higher perceived susceptibility and severity (Fig 1).
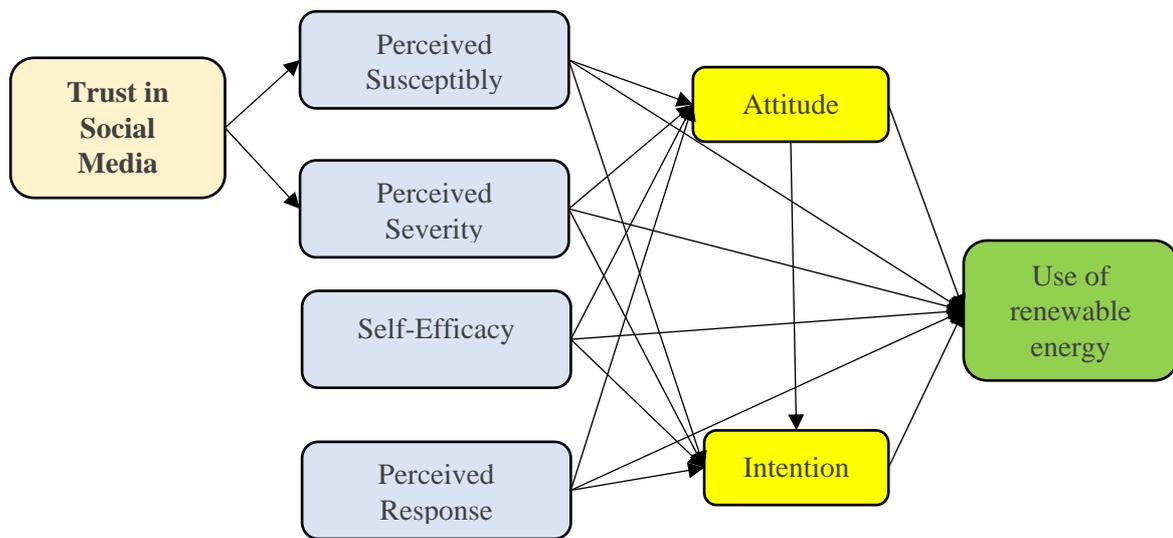
Figure 1. Modified Extended Parallel Process Model

Extended information adoption model

The information adoption model has been widely used in the socio-psychological context to explain how information is processed by individuals and which factors influencing information adoption. Adoption of information means the extent to which people accept content that is meaningful to them after evaluating its validity (Tseng and Wang, 2015).

According to this theory, there are two mechanisms or routes for accepting the message including central route and peripheral. The central path requires thinking critically about subject-related arguments in an information message, and scrutinizing the relative competence and relevance of the arguments before making conscious judgments about the target behavior (Bhattacherje & Sanford, 2006). Therefore, the quality of the argument obtained in a communication is a central cue in the information process. In this study, the proposed dimensions of Wixon and Todd, 2005 including Completeness, accuracy, currently, and format have been used for measuring argument quality.

The peripheral route relates to topics that are indirectly related to the message core (Erkan & Evans, 2016). Source credibility one of important factor that represents the peripheral cue (Sussman & Siegal, 2003). "Source credibility refers to the Source credibility refers to "the extent to which an information source is perceived to be believable, competent, and trustworthy by information recipients" (Bhattacherjee & Sanford, 2006). According to the information adoption model, central and peripheral

cues influence persuasive information through the usefulness of information. In addition, we have an attitude to information as added construct to the model. Petty and Cacioppo (1986) point out that both central and lateral pathways can lead to a change in people's attitudes and consequently a change in behavior. We also predict attitude to information can affect the perceived usefulness. Trust is also a mediator between perceived usefulness and information adoption (Shen et al., 2012).
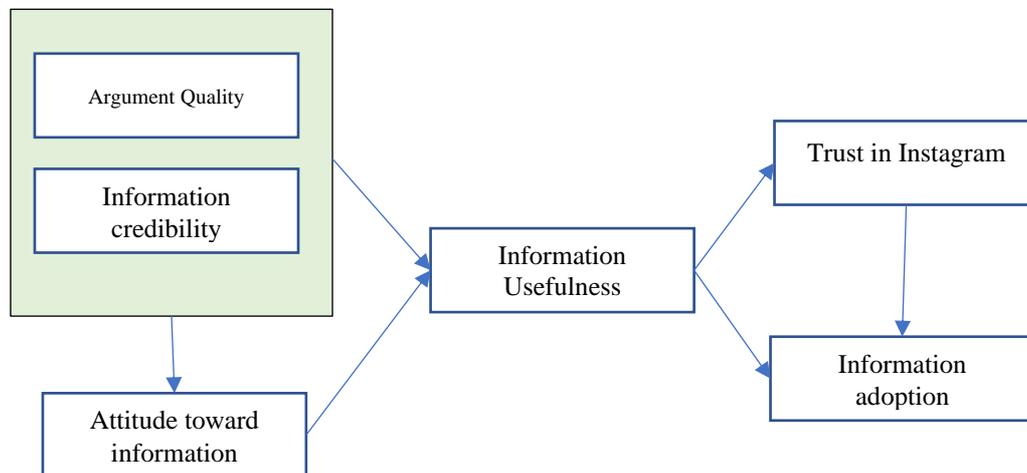
Figure 2. Extended Information Adoption Model

Methodology

To investigate the research hypotheses and determine the robustness of the EPPM and the Extended information adoption model in explaining intention and use of renewable energy, the structural equation model with maximum likelihoods algorithm was used by the AMOS program. An online survey was used to assess respondents' perceptions and their willingness to use renewable energy (Here solar energy). Sample of the study was Instagram users who followed pages related to renewable energy. Our assumption was that these people were interested in learning about renewable energy through Instagram and were exposed to renewable energy messages.

Multiple items were used to measure each of the research variables. All items were measured using a 5-point Likert scale (1 strongly disagree, 2 disagree, 3 neutral, 4 agree, and 5 strongly disagree). The content validity of the questionnaire was confirmed by a panel of experts and specialists. The reliability of each variable was evaluated using Cronbach's alpha coefficient. Cronbach's alpha values for all scales of the questionnaire were good to excellent (Table 2).

Results

Socio-economic characteristics

Table 1 shows the descriptive characteristics of the respondents. The mean age of the respondents was 30.71 (SD = 8.57) years. The respondents used social networks in average of 147 minutes (SD = 114.55) per day. The average number of family members was 4.37 (SD = 2.06).

Table 1. Profile of respondents

Demographic		Frequencies	Valid Percent (%)
Gender	Male	74	42.8
	Female	99	57.2
Age	Under 25	48	24.1
	25-35	82	35.9
	36-45	34	14.6
	46-55	6	15.9
	56 and over	3	9.5
	Middle school	3	1.8
Education level	High school	5	2.9
	Diploma	8	4.6
	Associate's degree	8	4.6
	Bachelor degree	58	33.5
	Master's degree	53	30.6
	PhD	38	22
Home ownership status	Owner	113	71.5
	Tenant	45	28.5
Type of house	Detached house	78	49.1
	Apartment	81	50.9

Main analysis

Structural equation modeling (SEM) was used to test the hypotheses and investigate the explanatory power of research theories in predicting the use of renewable energy. According to Anderson and Gerbing's, (1988) SEM consists of two stages: confirmatory factor analysis (CFA) and structural equation modeling. CFA is used to evaluate the suitability and quality of the measurement model by examining the reliability, convergent validity, and then structural equation modeling is used to confirm hypothetical or theoretical models.

Measurement model

As shown in table 1, the measurement models (two measurement model of EPPM and Extended information adoption model) provided a good fit to the data.
The internal correlation in the measurement model was examined through Cronbach's alpha. Since Cronbach's alpha values were above the acceptable threshold of 0.7; the structures had internal correlation or reliability. The Composite Reliability (CR) and the Average Extracted Variance (AVE) are two indicators for convergent validity. CR higher than 0.7 and AVE higher than 0.5 indicate good validity. In this study, the CR and AVE values for all constructs in two models were above the acceptable thresholds. Therefore, both measurement models have convergent validity.

Table 2. Fit indices of models

	Models	Chi-square	df	p	χ^2/df	GFI	CFI	IFI	RMSEA
EPPM	Measurement model	512.840	462	0.0001	1.543	0.811	0.929	0.931	0.056
	Structural model	737.953	467	0.0001	1.580	.806	.924	.925	.058
Extended information adoption model	Measurement model	557.289	305	0.0001	1.827	0.815	0.924	0.925	0.069
	Structural model	574.425	311	0.0001	1.847	.810	.921	.922	.070

Table 3. Construct validity

Extended Parallel Process Model				Extended Information Adoption Model			
Construct	**AVE**	**CR**	**alpha**	**Construct**	**AVE**	**CR**	**alpha**
Trust	.72	.91	.87	Argument quality	.63	.93	.93
Perceived Susceptibility	.72	.91	.87	Source Credibility	**.63**	.87	.86
Perceived Severity	.70	.87	.79	Attitude	.62	.86	.86
Perceived Self-efficacy	.66	.92	.89	Perceived Usefulness	.59	.85	.87
Perceived Response efficacy	.64	.90	.86	Trust	.65	.88	.87
Attitude	.71	.90	.86	Information adoption	.82	.60	.82
Intention	.71	.90	.86				

Structural model

As shown in table 1, the structural models (two model of EPPM and Extended information adoption model) provided a good fit to the data.

Figure 3 shows the structural equation modeling for the EPPM. Trust in the source of information affects perceived threats. In fact, trust in Instagram has affected the perceived susceptibility and severity. Perceived susceptibility was a direct predictor of attitudes toward renewable energy use ($\beta = 0.53$; p <0.01) and behavior ($\beta = 0.60$; p <0.01). Perceived severity was a predictor of intention ($\beta = 0.45$; p <0.01) and renewable energy use ($\beta = 0.62$; p <0.01). Perceived self-efficacy was able to predict attitude ($\beta = 0.29$; p <0.01), intention ($\beta = 0.25$; p <0.01) and behavior ($\beta = 0.51$; p <0.01). The perceived effectiveness of the response could only predict attitude ($\beta = 0.44$; p <0.01). Results showed, the intention has mediated between attitudes towards the use of renewable energy and the use of renewable energy. The improved EPPM was able to predict 22% of the changes in the intention to use renewable energy and 59% of the variance in the behavior of the use of renewable energy.
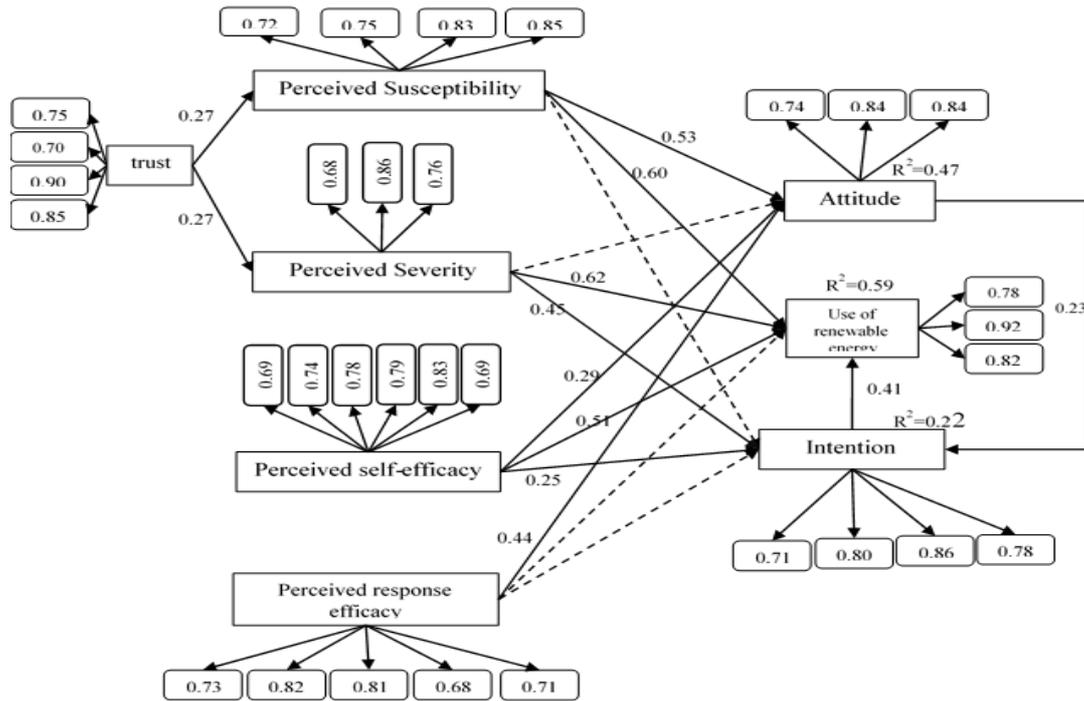
Figure 3. Structural equations modeling and path coefficients (EPPM)

Figure 4 shows the structural equation modeling of the extended information adoption model. Based on the findings, argument quality was a predictor of perceived usefulness ($\beta = 0.74$; $p < 0.01$), although it did not have a direct effect on attitudes toward information. The source credibility can predict attitude toward information ($\beta = 0.36$; $p < 0.01$). Attitude in turn, had a significant direct effect on perceived usefulness ($\beta = 0.18$; $p < 0.01$). Perceived usefulness in turn affected both the variables of trust in Instagram ($\beta = 0.66$; $p < 0.01$) and information adoption ($\beta = 0.78$; $p < 0.01$). Trust in Instagram directly affected the acceptance of information ($\beta = 0.17$; $p < 0.01$). Therefore, trust played a mediating role between perceived usefulness and acceptance of information.
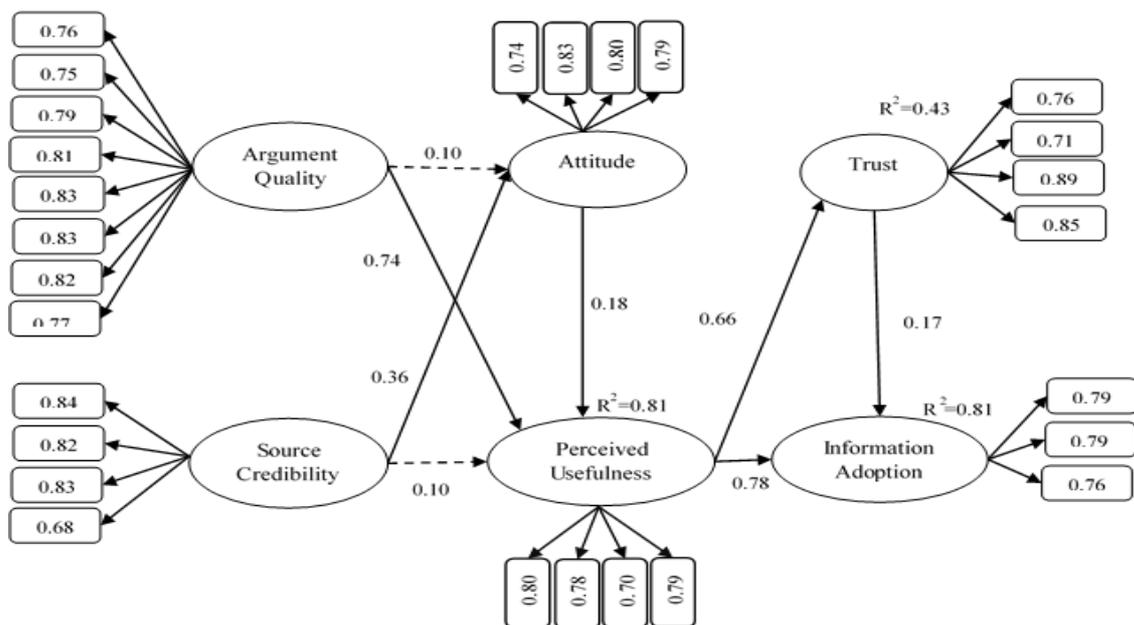
Figure 4. Structural equations modeling and path coefficients (Extended Information Adoption Model)

Discussion

Since climate change is a global issue, the implementation of renewable energy as a reduction strategy should be an important issue in countries around the world. An important part of the process of implementing renewable energy is its acceptance by laypeople. Social media Using messages can lead people to environmental measures, including the use of renewable energy. This study used two improved EPPM models and an extended information adoption model to investigate how social media influences the use of renewable energy.

According to the findings, in first model, after receiving information, people will feel higher perceived threats if they have high trust in the source of information. Also, according to the second model of the study, perceived trust is a direct predictor of information adoption and a mediator between perceived usefulness and information adoption. Studies in the field of climate change have paid special attention to trust in the media. Slovic (2000) believes that trust is a psychosocial factor that affects the perception of risk (Cited in Leiserowitz, 2006). The level of trust in information helps the human mind to interpret the outside world and thus affects people's perceptions of the subject. Trusted information about a problem, such as climate change, in which cause and effect are complex and scattered, can facilitate positive adaptive change, or vice versa, for example, where the problem is due to uncertainty, denial may have acted as a barrier (Niemeyer et al., 2005). Trust is an important factor in supporting climate change mitigation efforts (Hmielowski et al., 2014). People who have high trust in information gained from the media and experts are less concerned about the problem of climate change than people with low trust (Kellestedt et el., 2008). People pay attention to information about an issue such as climate change and incorporate it into their decisions if the information comes from a trusted source of information (Stoutenborough & Vedlitz, 2014; Spence et al. 2012).

According to the finding analysis EPPM, both perceived susceptibility and severity have a direct impact on the use of renewable energy. In fact, when people think the consequences of using fossil fuels dangerous and serious, they are likely to increase their use.

Three predictors of perceived susceptibility, self-efficacy and response efficacy were able to predict attitudes towards the use of renewable energy. In other words, how people more feel threatened, or more think they have the ability to use renewable energy, or more think use of renewable energy is useful in reducing environmental damage and consequences, likely they will have more positive attitude towards renewable energy use and then they will consider the use of renewable energy as a wise, desirable and useful behavior. In addition, the attitude was predictive of intention, which is consistent with the findings of the study (Yazdanpanah et al., 2015a).

Based on the findings, the intention was direct predictor of the use of renewable energy. Ajzan (2011) in a general definition defines intention as the readiness of an individual to perform a particular behavior and refers to the decision of individuals to perform a behavior. It is hypothesized that intention can represent the efforts an individual may make to achieve a goal or modify behavior (Zampetakis et al., 2013). This is consistent with the findings of the study (Liu et al., 2013).

Our finding shows importance of perceived self-efficacy. Because perceived self-efficacy has been able to predict all three dependent variables of research including attitude, intention and behavior. Self-efficacy refers to a person's beliefs or confidence in their ability to perform tasks effectively (Bandura, 1986). In fact, when people feel the ability to use renewable energy, the attitude, intention and behavior of using renewable energy will increase.

One of the important points obtained from the analysis of the extended information adoption showed that the argument quality has been able to affect the perceived usefulness. In other word, when think that the information obtained from Instagram is more accurate and up-to-date, they will perceive the usefulness of that information. Perceived usefulness in turn has also been able to influence the acceptance of information. Therefore, it can be concluded that perceived usefulness has been a mediator between the argument quality and information adoption.

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