International Conference on Social and Political Issues (ICSPI 2016)
International Conference on Social and Political Issues (the 1st ICSPI, 2016)
"Knowledge and Social Transformation"
Volume 2018

KnE Social Sciences

Knowledge E
Engaging minds

Conference Paper

Factor Analysis of Perceived Mobile Applications Use

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Abstract

Individual evaluation toward technology may influence adoption or usage of a new technology particularly instant messaging applications on smartphones. Davis (1989) introduced two main concepts that explain people's usage and rejection of a technology; perceived ease of use and perceived usefulness. Perceived is an important factor to develop intention to use, to motivate, to affect, to predict, to explain, and to increase technology acceptance. As a concept, perceived also grows based on various contexts such as perceived usability, perceived enjoyment, perceived quality, perceived aesthetic, and perceived expressiveness. Those concepts were used to analyze information and communication technology acceptance particularly electronic mail (e-mail), mobile social games, social networking sites, and mobile apps. This article discusses elaboration of perceived mobile apps use as a main concept to explain instant messaging applications use. By applying a quasi-experiment, this article analyzes the confirmation factors of perceived instant messaging application use. This article reveals that perceived could be elaborate into main concepts of mobile applications use from psychological motives.

Keywords: perceived, instant messaging, applications, factor analysis, quasi experiment

Received: 19 March 2018
Accepted: 27 July 2018
Published: 29 August 2018

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICSPI 2016 Conference Committee.

1. Introduction

Acceptance, adoption and use of information and communication technology has become an interesting study. Researchers believe the technology can improve work performance and has other positive implications [4]. However, Davis (1989) noted it is not coupled with the wishes of the user and even reject the technology especially end-user technology that is widely used by general public such as smartphones.

The use of mobile applications or mobile apps has increased dramatically as the high adoption of smartphone technology [10] and the subscription of wireless Internet network [35]. The high adoption of smartphones is considered that the technology is

more intuitive than other technologies. The touch screen smartphone is very flexible and can be customized by the user. It allows inclusive visual display so that the device is able to be accessed to a broad population [16]. Inclusiveness of user interface on tablet devices and smartphones emerged as the touch screen method to familiarize the user interacts with the device using both thumbs [19]. This makes the user and the mobile device has intuitive appeal. So that users can access the device anywhere as good as walking, sitting or sleeping [13]. Wireless Internet network subscription also allows the user always connected with Internet even in a state of high mobility [35]. The presence of 3G technology, 4G and 5G has increase the rate of downloads and mobile apps usage [26]. Moreover, the speed of Wi-Fi networks 5G makes users easier to transfer the data that causes smartphones and tablets as the "home screen" to do various things [23].

Mobile apps have changed the way of using the media. Half the millennial generation prefers watching video on a smartphone or tablet than television [7]. Ericsson Consumer Lab (2015a) also stated that since 2012 the number of viewers of video on smartphones has increased 71 percent and the average length of time to access became to three hours per week. Videos such as television programs, movies and music video clips are accessed via smartphone at least once a week [17]. Similar changes occurred in children who prefer a smartphone or tablet for watching videos and socializing online [18]. Instead, Ofcom (2014) reported that the use of television, game console, personal computer (PC) or varieties of stationary devices has declined. However, this reduction was not drastic. Ericsson Consumer Lab (2012) noted that only seven percent decline since 2011. Moreover, stationary devices, particularly television, has a social aspect as "household campfire" or a gathering place for family [7]. So that there is a trend of people using diverse media even at the same time [12], or called 'digital omnivores' [1].

Mobile apps is a form of new communication media [10] which provides entertainment [31], news and information [33], instant messaging (Kim, et al., 2007) as well as space for advertising [9]. Mobile apps based entertainment content is an application providing music, videos, novels and comic books. Users access music scene at least once a week with most users aged 16 to 24 years [17]. Music application used not only to listen but also to learn and make music [34]. Then mobile apps that provide video services are also popular because of the ability of audio visual quality on mobile devices [27]. Ofcom (2015) noted watching video from mobile devices increases every year. More than half of the mobile device user has gained access to video applications either watch online or download [17]. Meanwhile novels and comics can also be

accessed via apps electronic reader (e-reader) that allows the user to buy an electronic book [24].

Besides overcoming boredom, mobile apps also provide news and information. Almost all users (97%) find news and information on the smartphone to spend leisure time, health-related information, and the latest news at least once a week [17]. Weiss (2013) noted that smartphone users are young people aged 16-29 years. They are active news consumers and tend to look for local news. So that location-based mobile apps helps to transmit the local online news following the physical location of the user [33] such as local crime news (robbery, assault, fire), review local restaurants or news related construction projects that have an impact on travel.

Communication mobile apps, or well known as instant messaging, a transient medium used to check in without the requirement an immediate response, to set up a face-to-face meeting, to signal one's accessibility, to track the accessibility of others (e.g., whether they are logged on or not) and for chatting and discussing issues, all fostering increased closeness in the workplace (Kim, et al., 2007). Users use instant messaging for day-to-day conversations with a range of friends (Lenhart, Madden & Hitlin, 2005). It is similar with a study conducted by Boneva, Quinn, Kraut, Kiesler, and Shklovski (2006) shows that young users 13–18 year-olds found that conversations using instant messaging were more social than face-to-face visits or phone conversations.

In addition, mobile apps is also a multi-modal digital technology [9]. Digital application enables various forms of content has the structure of the smallest bits [15]. So that various forms of content previously accessed through different mediums (audiovisual content on television, audio content on radio and visual content on newspaper or magazine) be accessible through mobile apps. It implies a dynamic form of communication [9]. Communication through mobile apps not only in the form of voice and text, but it can be a real time voice, audio, video, images, photographs, emoticons, or a combination of them.

Mobile apps grow exponentially. As the winter of 2015, Google Play contained 1.8 million mobile apps in its online store. Apple App Store has 1.5 million and Amazon App-Store has 400k mobile apps [6]. Competition to user's limited attention is tremendous [36]. Positive evaluations and perceived mobile application are important to maintain the apps market. One of the perceived technology concept was introduced by Davis (1989), is the motive of human psychology to explain the behavior of accept or reject the technology. Perceived (feeling / belief / evaluation of the individual) became one

of the important factors to form the intent to use [4], to motivate [26], to influence [32], to predict [35], to explain and to improve [5] technology acceptance.

Various studies indicate perceived mobile applications influence intention to adopt and intention to continuance use. Shin (2012) shows that perceived enjoyment, perceived quality, perceived usability and perceived aesthetic influence attitude toward mobile apps. Yang (2013) also shows perceived usefulness, perceived ease of use, perceived enjoyment and perceived expressiveness positively influence attitude, meanwhile perceived usefulness has a positive impact on intention to use mobile apps. Hassan and his colleagues (2014) prove that perceived usefulness, perceived ease of use and perceived enjoyment highly influence intention to adopt new mobile apps.

Davis (1989) defines perceived usefulness as "the level of a person believes that using a particular system or technology will improve the performance of work". While the perceived ease of use is defined as a "level one is sure that using a system would be free of any effort" [4]. Perceived usefulness and perceived ease of use is an internal instrument for predicting the possibility of a new technology adoption. Davis (1986) also explains that cognitive and affective responses as predictors of actual behavior of technology usage.

Perceived enjoyment was introduced Davis, Bagozzi and Warshaw (1992) to explain the intrinsic factor that affect technology acceptance. Perceived enjoyment is defined as perceived fun activities using a computer [3]. Verkasalo (2008) shows the different types of mobile applications such as e-mail, multimedia message system (MMS) as well as gaming determine the perceived level of enjoyment. It also applies to the types of devices usage, smartphones or tablets. Perceived enjoyment becomes a major predictor of customer attitudes [14]. Besides in the context of the use of websites, perceived enjoyment positively influence user's attitude toward websites [29].

Perceived expressiveness is identified the hedonic motives of using new communication technologies – the need for entertainment, pleasure, passing time, social interaction, sociability, immediate access, fashion, status, expressiveness and time management [35]. Moreover, Yang (2013) explains perceived expressiveness is drawn upon the Uses and Gratifications Theory of communication that treats mobile apps as a medium that fulfills young consumer's communicative, informational, social and entertainment needs.

A study was conducted by Shin (2012), proposed a new variable, perceived quality and perceived usability. Perceived quality is closely related to the utility (hardware) and software. The quality of the device is an important factor in mobile services to increase the use of technology [26]. Some of the things that often occur due to quality

reduction are response delay, disconnection, limited access and poor security [25]. Besides the quality of the technical side, mobile apps also can be seen from the quality of the information or content. Usability is considered as one of the determinants of user attitude and intention (Lee and Koubek, 2010). There is a significant relationship between user's perceptions of usability and their attitude toward a system (Dillon, 2001). System usability also affects user evaluations of usability and aesthetics. Thus, the effects of perceived usability on attitude, intention, and preferences have been extensively researched and confirmed [26].

Shin (2012) also examined perceived aesthetic as an important factor in the Technological Acceptance Model (TAM) as it may affect the evaluation of usability [28]. Perceived aesthetic is measured based on user perception of the aesthetic and visual display interface. Van der Heijden (2001) introduced new variables associated with visual, "perceived visual attractiveness". Perceived visual attractiveness is defined as the perception of the user who assess the aesthetics of a website delightful view [29]. The allure of the websites is assessed visual elements such as the use of color, layout, and features that exist in the website. Perceived visual attractiveness shows a correlation with the ease of use, enjoyment and usefulness [29].

2. Methods

Aquasi experiment was conducted to collect the data from 117 users of mobile apps. Users of mobile apps were invited to participate on voluntary basis. At least more than 150 users were interested on the invitation, however, only 117 users were suitable with the criteria. The criteria are (1) 17-30 years old; (2) using mobile apps at least one apps per day with minimum 30 minutes of duration; (3) able to participate without leaving early; (4) having their own device as a part of experiment; and (5) understandable to follow the instruction.

Quasi experiment was opted since participants did not get any special treatment either on special mobile apps or specific smartphone devices. The selected participants were asked to open any mobile apps for 30 minutes. Then they were instructed to fill the instrument on Google Form after using the apps. The instrument was consisted of three section (1) consent form and the instruction; (2) seven dimension of various perceived with 37 items of statement, and (3) demographic data.

This study examined seven variables that is proposed as dimension of perceived mobile apps use. First, perceived usefulness is composed by nine indicators. People find mobile apps is (1) useful. By using it, people can (2) save time, (3) improve the

efficiency, (4) be connected, (5) communicate wherever (6) and at any time with friends, (7) receive timely information, (8) receive information exclusively, (9) receive the customization news [35].

Second, perceived ease of use consists of nine indicators that people find it is easy to (1) learn, (2) operate, (3) use, (4) study the materials, (5) work with mobile apps. People also feel (6) interactions are clear and understandable, (7) saves time and effort, and (8) tends to carry a smartphone than a laptop because (9) because smartphone as a mobile telephone and computer (Hassan, et al., 2014; Yang, 2013). Third, perceived enjoyment is composed by seven indicators. People enjoy (1) using and (2) doing many things with mobile apps when (3) having leisure time, (4) interacting with others, and (5) feeling encourage with the new functions of mobile apps. Individuals also feel smartphones are (6) fun and (7) entertained (Hassan, et al., 2014; Shin, 2012).

Fourth, perceived expressiveness consists of three indicators: (1) talk about mobile apps with others, (2) use the mobile apps are part show personality and (3) use the mobile apps to make other people admire [35]. Fifth, perceived quality is composed of three indicators, namely the individual feels mobile apps provide (1) a reliable service, (2) the service and valuable information, and (3) in accordance with the requirements [26].

Sixth, perceived usability consists of four indicators. Individual evaluations related to mobile apps are (1) useful, (2) practical and functional, (3) clear display and easy to understand and (4) easy to control when faced with technical problems [26]. Finally, perceived aesthetic is composed by three variables. People feel mobile apps is (1) attractive looking, (2) visually appealing and (3) good design [26].

All the indicators were measured by Likert scale 5. Five-point scale once used by Lin (2013) to measure the acceptance of the technology by using experiments. The scale range is also considered ideal for distance intervals are too wide scale will lead to the possibility of change in intention (Callahan, 1997).

This study proposed 37 items of perceived mobile apps use. These big number of items can become rather complicated and could be some of the variable measure different aspects of a same underlying variable. For situation such as there, factor analysis attempts to bring intercorrelated variables together under more general, underlying variables. More specifically, the goal of factor analysis is to reduce "the dimensionality of the original space and to give an interpretation to the new space, spanned by a reduced number of new dimensions which are supposed to underlie the old ones" (Rietveld & Van Hout 1993: 254), or to explain the variance in the observed variables in terms of underlying latent factors" (Habing 2003: 2) Thus, factor analysis offers not

only the possibility of gaining a clear view of the data, but also the possibility of using the output in subsequent analyses (Field 2000; Rietveld& Van Hout 1993).

2.1. Results and discussions

This study collects numerical data consisting of demographic data and quasi experiment data. The demographic data, this study used univariate analysis techniques to describe the participants in each group (Babbie, 2004). Before continuing the analysis, the data to test the validity and reliability. Then, the demographic results show that most respondents were in the age range 21-22 years (42.7%) with the first use of smartphones around the year 2011 to 2013 (51.3%). This shows the millennial generation using smartphones since the age of about 15-17 years of age or in the age of high school. Then the majority of respondents (98.3%) subscribe to internet data services with an average subscription fee of Rp 92 696.

Principal Components Analysis (PCA) was used as factor analysis extraction methods. PCA is the default method of extraction in many popular statistical software packages, including SPSS and SAS and commonly used in various studies [2]. Besides, rotation method used varimax to simplify and clarify the data structure.

All dimensions were observed to be valid (Kaiser-Meyer-Olkin Measure of Sampling Adequacy value = 0.896). Then test Bartlett's Test of Sphercity with statistical significance of 2967.619 with a coefficient of degree of freedom (df) is 666 and the significance is zero. As the result, the observed dimensions were considered satisfactory and could be processed on the next stage of statistics. Since this study have reported scale construction on several dimensions and numbers of items, the study used exploratory factor analysis (EFA). The EFA was used to determine by how many items or dimensions were kept after analysis [2].

Correlation matrix reveals interrelated items which determine unique contribution each items into factors. The results show all items as an identity matrix that would be no correlations between the variables or multicollinearity [8]. In addition to communalities, the result of item communalities are between 0.563 and 0.847 which considered "moderate to high". The value was interpreted as moderate to high magnitude [30]. The items and dimensions were related to other.

All items show 71,83% initial eigenvalue (71.831) which explain to perceived mobile apps. Factor 1 accounts for 33.12% of the variability in all seven variables. Factor 2 accounts 9.38%. Factor 3 accounts for 7.47% of the variability in all seven variables. Factor 4 accounts for 6.56% of the variability in all seven variables. Factor 5 accounts

for 6.33% of the variability. Factor 6 accounts for 4.56% of the variability in all seven variables. Meanwhile factor 7 accounts for 4.37% of the variability in all seven variables.

The rotated component matrix shows the factor loading of each variable. The factor that each variable loaded most strongly on is highlighted. Based on these factor loadings, the factor will be represented as perceived usefulness loaded strongly in factor 1 which consisted six items (PU_A3, PU_A4, PU_A5, PU_A6, PU_A7 and PU_A9). Perceived ease of use loaded strongly in factor 1 which consisted two items (PEoU_B1 and PEoU_B2). Perceived usability loaded strongly in factor 1 which consisted three items (PUs_C1, PUs_C2, and PUs_C3). Perceived enjoyment loaded in factor 1 which consisted five items (PE_D1, PE_D2, PE_D3, PE_D4, and PE_D7). Perceived quality loaded strongly in factor 1 which items as same as proposed. Perceived aesthetic loaded strongly in factor 1 which consisted two items (PA_F1 and PA_F2). Meanwhile perceived expressiveness loaded strongly in factor 4 which consisted two items (PEx_H1 and PEx_H3).

Table 1: Rotated Component Matrix.

	Component						
	1	2	3	4	5	6	7
PU_A1	.294	.695	.139	-.090	.282	-.042	.047
PU_A2	.501	.570	.207	.081	.206	-.167	-.013
PU_A3	.765	.339	.166	.013	.099	.106	.001
PU_A4	.829	.171	.129	.002	.081	.272	.014
PU_A5	.854	.232	.111	-.011	-.052	.162	.004
PU_A6	.817	.146	.221	.064	-.011	.136	.076
PU_A7	.660	.047	.476	.178	-.027	.152	-.109
PU_A8	.362	-.083	.203	.425	.169	.507	-.238
PU_A9	.642	-.077	.319	.247	.052	.113	-.073
PEoU_B1	.631	.115	.265	-.096	.102	.396	-.060
PEoU_B2	.672	.238	-.013	.104	-.058	.173	-.109
PEoU_B3	.341	.604	.002	-.002	-.127	.397	-.060
PEoU_B4	.416	.594	.288	.101	.013	.173	.201
PEoU_B5	.303	.184	.008	-.124	.047	.784	.256
PEoU_B6	.181	.497	.414	.144	.030	.309	.288
PEoU_B7	.303	.162	.737	.031	.219	.048	-.117
PEoU_B8	.320	.120	.748	.120	.019	-.021	.030
PUs_C1	.788	.384	.112	.139	.134	.080	-.020
PUs_C2	.790	.359	.189	.079	.099	-.015	-.068
PUs_C3	.632	.373	.157	.063	-.022	.195	.056

	Component						
	1	2	3	4	5	6	7
PUs_C4	.202	.492	.581	.203	.145	.101	.232
PE_D1	.760	.049	.159	-.055	.205	.125	.068
PE_D2	.830	.213	.149	-.045	.097	.048	.104
PE_D3	.619	.149	.262	.131	.183	.155	.112
PE_D4	.745	.130	.260	.007	.025	.079	.325
PE_D5	.072	.114	.113	.118	.918	.029	.132
PE_D6	.183	.091	.092	.197	.892	.049	.088
PE_D7	.614	.449	.093	.291	.151	.108	.017
PQ_E1	.631	.245	.189	.421	.009	.064	.129
PQ_E2	.722	.186	.221	.219	.166	.013	.163
PQ_E3	.670	.220	.233	.249	.210	.001	.204
PA_F1	.519	.203	.071	.271	.317	.083	.325
PA_F2	.559	.372	-.120	.202	.134	-.098	.344
PA_F3	.047	.062	-.008	.099	.173	.093	.846
PEx_H1	.241	.113	.064	.781	.054	-.005	.189
PEx_H2	.700	.129	.007	.410	.165	-.014	.174
PEx_H3	-.065	-.031	.126	.797	.207	-.057	-.021
Extraction Method: Principal Component Analysis.							
Rotation Method: Varimax with Kaiser Normalization.							
a. Rotation converged in 10 iterations.							

Factor analysis conceptualized perceived mobile applications' dimensions statistically. Perceived usefulness was reduced to six indicators. People perceive using mobile apps can (3) improve the efficiency, (4) be connected, (5) communicate wherever (6) and at any time with friends, (7) receive timely information, and (9) receive the customization news. Perceived ease of use was composed by only two indicators that people find it is easy to (1) learn, and (2) operate mobile apps. Perceived usability was changed to three indicators which Individual evaluations related to mobile apps are (1) useful, (2) practical and functional, and (3) clear display and easy to understand. Perceived enjoyment is consisted of five indicators about how people enjoy (1) using and (2) doing many things with mobile apps when (3) having leisure time, (4) interacting with others, and (7) entertained. Perceived quality had not changed. It is composed of three indicators, namely the individual feels mobile apps provide (1) a reliable service, (2) the service and valuable information, and (3) in accordance with the requirements. Meanwhile, perceived aesthetic had remained two indicators; (1) attractive looking, (2) visually appealing. Finally, perceived expressiveness was reduced to two indicators;

(1) talk about mobile apps with others, (2) use the mobile apps to make other people admire.

3. Conclusion

Perceived mobile applications use is important factor to recognize new mobile communication technology that grows significantly recently. Many researchers have developed any perceived sensing of mobile apps. This study constructed and proved that most of dimensions and items of perceived mobile apps use could be elaborated into one variable. In addition to the elaboration of items, the communality of perceived mobile applications use is considered moderate to high magnitude.

Items of perceived mobile applications use explained 71.83%. However, there are 28.17% unexplained items that have not been studied. Therefore, further study should explore more perceived mobile applications use. In addition, the next study should develop perceived mobile applications use either as independent or dependent variable. So, the perceived mobile applications use may relate to other variables that have been considered as a model, concept, or theory on psychological motives.

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Appendix-1

Questionnaire

Construct	Statement	Extraction Value
PU	**Perceived Usefulness**	(Hassan, et al., 2014; Yang, 2013).
	Mobile applications are useful to me	
	Using mobile applications saves me a lot of time	
	Using mobile applications improves my efficiency	
	I stay connected with my friends with mobile applications	
	I communicate with my friends anywhere via mobile applications	
	I communicate with my friends anytime via mobile applications	
	I receive timely information via mobile applications	
	I receive exclusive information via mobile application	
	I receive customized news to my liking via mobile applications	
PEoU	**Perceived Ease of Use**	(Hassan, et al., 2014; Yang, 2013).
	Learning to use apps is easy to me	
	It is easy to use mobile applications	
	Smartphone apps enables me to receive learning materials anywhere I go	
	Smartphone apps allow me to accomplish task more quickly	
	My interaction with apps is clear and understandable	
	In my work, smartphone apps saves my time and effort	

Construct	Statement	Extraction Value
	I would prefer carrying my smartphone rather than my laptop	
	Having a smartphone is like having both a mobile phone and a computer together	
PE	**Perceived Enjoyment**	(Hassan, et al., 2014; Shin, 2012; Yang, 2013).
	I enjoy using mobile applications	
	I enjoy doing things with mobile applications	
	It is enjoyable to use apps during idle time	
	It is enjoyable to have social interaction with significant others	
	The novel functions of apps excite me to adopt them	
	I find mobile applications exciting	
	I find mobile applications entertaining	
PEx	**Perceived Expressiveness**	(Yang, 2013)
	I often talk to others about mobile applications	
	Using mobile applications is part of how I express my personality	
	Other people are often impressed by the way I use mobile applications	
PQ	**Perceived Quality**	(Shin, 2012)
	I think that mobile apps provide very reliable service	
	I think that the services and information I can get from a mobile apps are valuable	
	Mobile apps provide the information and services that I need	
PUs	**Perceived Usability**	(Shin, 2012)
	I evaluate mobile apps as useful	
	I evaluate mobile apps as practical and functional	
	I think smartphone make people feel that the interface design and information delivery are clear and easy to understand	
	I feel mobile apps are easy to handle when I encounter problems	
PA	**Perceived Aesthetic**	(Shin, 2012)
	Overall, I find that mobile apps look attractive	
	The overall look and feel of smartphones is visually appealing	
	Overall design of mobile apps is good-looking	