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Research Article

An Assessment of Effective Factors in Technology Acceptance Model: A Meta- Analysis Study

Abbas Doulani

Department of Knowledge and Information Science, Alzahra University, Tehran, IRAN.

ABSTRACT

Purpose: The main object of this study is to identify the main factors which cause the acceptance or rejection of technology by the users. **Methodology:** In the present study; the results of studies conducted in the mentioned field were analyzed using statistical methods. The method applied in the current study was meta-analysis. In this study, all studies done in the mentioned field have been searched from three citation databases of ISI, Scopus and ISC, based on the presence of keywords TAM and Technology Acceptance Model in titles, abstracts, keywords, texts and references. For meta-analysis of the studies, means and standard error of variables in the studies were collected and their significance level was measured with the use of means differences. Then, based on tests applied in the studies, the effects size of the variables was calculated based on Hedges approach. Also, Cohen approach was used for their interpretation. **Findings:** Totally, 164 researches had the property of measuring the effect size. Given the obtained results, twenty-one-dimensional variables with different values are effective in the technology acceptance in environments and based on the type of samples in the studies. Given that all main variables in Davies model had high means and high effect size, it can be concluded that components of Davis' Technology Acceptance Model (TAM) are still considered as the ideal components in this field. **Originality/Value:** The article have a new methodology to technology acceptance or rejection causes.

Key words: Technology Acceptance, Meta-Analysis, Information and Communication Technology (ICT), Methodology, Davis Technology Acceptance Model (TAM).

Correspondence
Abbas Doulani
Department of Knowledge and Information Science, Alzahra University, Tehran, IRAN.
E-mail: a.doulani@alzahra.ac.ir

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INTRODUCTION

One of the underlying objectives of the studies in the field of information technology acceptance is to identify the main factors that lead to technology acceptance by people. This in turn promotes the technology and its acceptance by others. Over the past few decades, numerous theories have been presented to identify the effective factors in technology acceptance, in particular by theorists. For instance, presenting a model, King and Cleland (1971) addressed effective factors in declining the use of information systems by users. Schultz and Slevin (1983) postulated that technical and organizational factors influence information systems acceptance and sought to answer the question why some information systems that comply with all technical standards are not accepted or are not properly understood by users. In the same vein, various studies have been conducted to answer questions akin to the two above, which often did not provide a comprehensive explanation for the reasons for failures and lack of the acceptance of information systems.

Over the years after the introduction of Davis Technology Acceptance Model, a bulk of scholars have researched what individual, social, organizational and other factors exist that can affect Davis's two main factors i.e. the perception of usefulness and perception of the ease of use.[1] A review of the research in this field suggests that there are many variables that can influence the users' tendency or motivation of users to accept or reject new technology. In other words, each researcher, based on his or her own attitude and the characteristics of the sample under study, examine a number of variables in their research. On the other hand, the subject matter, context and the type of technologies under study is another issue. Issues such as the use of the Internet, e-government, e-learning and the use of information technology in various fields have been of great interest to researchers in the last few decades.[2]

Today, in areas such as knowledge management, information behavior, the information needs of users, the design of

information systems, webometrics and other decades, dozens or hundreds of research cases are carried out and their results are published in the form of books, articles and so on; however, there is a dearth of comprehensive analysis of the results of each field. This is while, in other areas such as social sciences, psychology, medical sciences, etc, meta-analysis methodology is of great importance for presenting relevant studies. Undoubtedly, the continuation of this process i.e. the lack of the use of meta-analysis methodology, does not allow for the aggregation of the results of research carried out in various fields to achieve a general consensus. In other words, non-aggregation of results, in spite of numerous patterns, models and opinions in the field of technology acceptance, will result in a dispersal and decentralization of targeted planning in the development of new technologies in organizations, societies and even at individual level.

Accordingly, in this research, the authors strived for an investigation and analysis of the studies on technology acceptance in ISI, Scopus and ISC citation databases to present homogeneous results using meta-analysis method.

Review of the related literature

In 1989, Davis presented an appropriate explanation for the tendency of users to use new technologies providing Technology Acceptance Model (TAM). Davis's Technology Acceptance Model was formulated based on a psychological theory known as TRA (Theory of Reasoned Action)[3] which was in turn considered a behavior theory. Davis's TAM is formed from two main variables i.e. Perceived Ease of Use (EU) and Perceived Usefulness (PU). These two factors explain user's actual use of new technologies by another third factor namely user's behavior intention derived from the reasoned action and by the interference of external and environmental variables. It can actually be stated that due to its understandability and easiness, Davis's TAM has extensively been used to explain the success or failure of information system.[4] An overview of the basic model of Davis can be shown as the following.

In the main Davis's TAM, Perceived Ease of Use and Perceived Usefulness of proposed technology are two main components which result in an increase in usage (model result). However, it is obvious that there are also many other variables that in return, can significantly affect the usage and acceptance or rejection of technology model in interaction with two above-mentioned elements or in combination with each other. Hence, researchers have so far examined a bulk of variables in Technology Acceptance Models. According to Yousafzai research,[5] so far nearly seventy variables have been studied by researchers in this regards.

Moreover, according to,[1] what cause to increase the output quality of a model is the external variables affecting the model. For instance, in the study carried out by Gefen (2004) in the field of electronic commerce, it was determined that given that the buyer has no physical contact with the seller or intermediary, the factor of trust extremely reduces the usefulness of sales systems that are one of two main elements in Davis's TAM. In contrast, a year later, in another study conducted by Geffen[6] on non-business information systems, according to the high security of information systems in storing personal and confidential information, the factor of trust had a positive impact on the usefulness of technology.

Venkatesh and Morris[7] believes that among from all technology acceptance models, Davis's model provides the most appropriate model to explain users' behavior in the use of technology). However, Legriss and colleagues [2] argue that Davis's model cannot be a perfect model; on the other hand, there are many factors and variables examined in the other technology acceptance models as factors affecting the users' use of new technologies. In several studies done in the field of technology acceptance models, in addition to various theories, other variables such as the users' demographic characteristics in terms of employment, age, sex, etc. have been examined that challenge the Davis's idealized model.

In general, studies using meta-analysis methodology, especially in the field of Library and Information Science (LIS) is followed with a much lower frequency by researchers. Pondering over the broad thematic areas of LIS field, one can easily recognize the dearth of such studies., a Since there are a bulk of research in numerous thematic areas including technology acceptance, knowledge management, organizing information, information seeking behavior, search engines etc., it seems quintessential to conduct a comprehensive meta-analysis study to collect and calculate the outcomes of such studies.

Based on the search conducted, few meta-analyses have been done in the area of information technology acceptance. In a study, King and He did the meta-analysis of technology acceptance studies based on variables of perceived usefulness, perceived ease of use, attitude and users' usage. The results showed that there was no significant difference between the correlations calculated between the above-mentioned variables (binary). There was also no significant difference between the mentioned correlations based on the type of users (meta-analysis subgroups including the public, students and organizations' staff). On the other hand, the difference between the calculated effect sizes indicated that among from types of users, based on the afore-mentioned variables, the calculated effect sizes were higher when studies were conducted on the public than on other types of users.[8] In another study, Yousafzai *et al* investigated the meta-analysis of technology acceptance studies published in the journal of modeling in management. The results revealed that the calculated

correlations were significantly more between the variables of attitude and behavior intention of users and between the perceived usefulness and behavioral intention among studies whose statistical samples were non-students. Also, in the studies examining various areas of technology, the above calculated correlations were significantly different from each other.[5] In another study; Scheper *et al* examined the meta-analysis of studies in the field of technology acceptance. They sought to measure the rate of social influence on the main variables in Davis's technology acceptance model. The obtained results showed that these factors affect behavioral intention and perceived usefulness. Also, the calculated correlations had significant differences between the main variables of Davis's model i.e. perceived usefulness, perceived ease of use, attitude and usage between the studies that surveyed student samples and those on non-student samples. An interesting result obtained from their findings was that on variables of Davis's technology acceptance model, the rate of social influence in studies performed in East was significantly more than that in West.[9]

In another study, Wu and Lederer[10] measured the effect of environmental factors on variables of perceived usefulness; perceived ease of use; usage and behavior intention of users. The study results indicated that environmental factors have significantly affected the variables. In another study, Turner *et al*.[11] did a systematic review on variables in various studies in the field of technology acceptance whose results indicated that the possibility of behavior intention is the major factor influencing users' usage of technology and subsequently its acceptance. In contrast, among the variables, perceived ease of use has the least effect. In another study, Wu investigated the meta-analysis of studies in the field of technology acceptance to measure the effect of trust on the main variables in Davis's technology acceptance model. Their results showed that trust is highly correlated with variables in Davis's model. It should be noted that the results of this study were completely verified through similar studies conducted by researchers and IT producers.[12] In another study, trust on informational systems and users' intention for its more use has been examined. The results revealed that trust of technology has a significant impact on users' use of technology.[13] In another study, Sumak and colleagues[14] did meta-analysis on the effective factors on technology acceptance by users in the field of e-learning and their study results indicated that both perceived ease of use and perceived usefulness had a large impact on users' acceptance to changing learning style to e-learning style. In another study, Legris *et al*.[14] conducted a qualitative meta-analysis in technology acceptance studies and to evaluate Davis's model, he considered the effect of social influence and type of users. The results indicated high correlation between social influence and type of users with Davis's model variables. Other studies with similar results have been done to measure the effects of external variables on Davis's information technology model. Studies by Wangpipatwong S, Chutimaskul W, Papasratorn B,[15] Lin Lin[16] and Wu P. F. Wu[17] can be mentioned in this respects.

MATERIALS AND METHODS

Addressing the primary sources in the field of the study topic was the main tool to gather information in the study. Articles entered in the analysis stage were searched in three citation databases of ISI, Scopus and ISC based on existing keywords of Technology Acceptance Model and TAM in the title, abstract, keywords, text and references. Also, in order to download the maximum articles, databases such as ACM, Science Direct, IEE Explorer and Google and Yahoo were searched. At this stage, after removing duplicates, a total of 1128 articles were searched regardless of the time period. In the next stage, articles searched by mistake due to various factors were extracted and removed from the related articles. These articles were removed from references for various reasons such as addressing technologies in the other areas, except for IT including agriculture and industry etc. or the similarity of the initials of TAM with those of various sciences such as pharmaceutical sciences or proper names (TAM). Also, given that in the meta-analytic method, all or a substantial portion of studies in the desired areas should be examined, the primary sources are the original research conducted and completed in the studied field. Accordingly, in meta-analysis method, using the summary of research having quantitative and flaw information is not possible. To increase the validity of the results, in addition to the above criterion in selecting studies, the following considerations were also taken into account:

A. Is it possible to calculate the effect size according to the available parameters?

B. Do the intended studies contain adequate information for quantitative composition?

C. Has an appropriate sampling technique been used?

D. Is the statistical method been used is appropriate?

H. What is the tool to collect data and have its validity and reliability been studied?

If the above cases in the studies were observed, then the studies were included in meta-analysis.

As it was mentioned, to combine results of various studies in a particular field, the primary method is meta-analysis. To analyze the collected data, two levels of meta-analysis were used. The descriptive data related to twenty-one-dimensional variables (Table 1) including mean and their standard error in any study was first collected and the confidence interval of each mean and P-value was calculated.

To analyze the collected means, the test of Means Difference was used. It should be noted that in meta-analysis, to calculate the difference between means, this test is used corresponding to test on case studies. After the above stages, in the level of subgroups i.e. based on the studied population (the public, organizations' staff and students) and the area of Information and Communication Technology (ICT) in general and e-government and e-learning, the above test was also done. Thus, the significance level of the studied variables was tested in the above levels. Therefore, in the present study, we seek to answer the following research questions:

1. What are the main and external variables effective in technology acceptance based on Davis's model?
2. How do the main and external variables affect technology acceptance in the public statistical population?
3. How do main and external variables affect technology acceptance in the statistical population of students?
4. To what extent are the main and external variables effective in technology acceptance in the statistical population of organizations' staff?
5. To what extent are the main and external variables effective in technology acceptance based on information technology acceptance (general)?
6. To what extent are the main and external variables effective in technology acceptance based on the technology acceptance e-government?
7. To what extent are the main and external variables effective in technology acceptance based on the technology acceptance e-learning?
8. How much is the effect size of the factors and variables affecting Information and Communication Technology?

Also, by Q-test, the homogeneity degree of studies was examined. It should be noted that any heterogeneity and lack of uniformity among the investigated studies can have different sources among which the number of studies, the number of samples examined in studies entered in the meta-analysis and using the instrument to collect the data and different methodologies can be mentioned. To calculate the homogeneity degree, the simple X^2 test is done. The value of this parameter is calculated using the following formula. In meta-analysis, X^2 is displayed by Q. In other words, to calculate the degree of

Table 1: Definition of Main and Broad Variables in Technology Acceptance Model.

Variables	Definitions
Intention	An individual's behavioral intention to use information technology.[18]
Attitude	An individual's overall evaluation toward using information technology.[19]
Subjective norm	Users' perception of whether other important people perceive they should use information technology.[18]
Behavioral Control	Users' perception if they have the necessary resources and capability in successfully using information technology.[18]
Usefulness	Users' feelings of improved performance when they use information technology.[1]
Ease of use	An individual's perceived exerted efforts when using information technology.[1]
Enjoyment	The extent to which an individual perceives that the use of IM is enjoyable, aside from performance outcomes associated with using information technology.[20]
Computer anxiety	An individual's apprehension or even fear, when she/he is faced with the possibility of using computers
Computer self-efficacy	Computer self-efficacy represents an individual's perception of his or her ability to use computers in the accomplishment of a task.[21]
Organ support	Organizational facilitating conditions are defined as the degree to which an individual believes that a satisfactory level of organizational and technical infrastructure exists to support use of the system.[21]
Social influence	"The degree to which an individual perceives that important others believe he or she should use the new system.[22]
Job Relevance	"Individual's perception regarding the degree to which the target system is applicable to his or her job.[23]
Trust	The degree to which a user feels protected against security threats resulting from the use of information technology.[24]
Information quality	The extent to which a user believes that the use of information technology would generate desired outcomes.[25]
System quality	The quality of an information system must be examined in three dimensions of information, system and service quality.[26]
Behavioral Intention	Behavioral intention determines a person's performance of a specified behavior to perform the behavior and behavioral intentions jointly determined by the person's attitude and subjective norms concerning the behavior in question.[3]
Usage	An individual's rate toward information technology usage.[27]
Compatibility	Compatibility is the degree to which the innovation is perceived to be consistent with the potential users' existing values, previous experiences and needs.[28]
Innovation	Innovation characteristics research describes the relationship between the attributes or characteristics of an innovation and the adoption and implementation of that innovation.[29]
Availability	The degree to which users to have access to a technology.[23]

homogeneity, the difference of index value calculated in each study of its overall estimate (result of meta-analysis) should be squared and multiplied by the weight of the mentioned study. The sum of these values will be Q and the degrees of freedom of this parameter will be equal to the number of studies minus one.[30]

$$Q = \sum w_i (y_i - \bar{y})^2$$

Also, given that all variables in each of 164 desired studies have not been investigated, the significance level for two above tests was counted according to the number of studies for each variable and the number of studied samples.

In the next stage, collecting data was continued in the level of answers of tests in a way that all parameters in the studies selected were converted to correlation index (r) based on Hedges approach and then, to interpret the effect size of each of them, Cohen approach was applied. This approach has been one of the main approaches in meta-analysis used in recent years. In other words, the most common indicators used in meta-analysis are indices of r, d and g. the indicators of d and g were devised by Cohen and Glass, respectively. Index r presented by Hedges is for correlation studies. In the present study, given that most studies have correlation, index r was used and other parameters such as the coefficient of square (X^2) and t etc. were transformed into index r using the conversion formula presented below.

1. To convert the coefficient of square (X^2) into r, the following formula was used: $r = \sqrt{\frac{x^2}{n}}$

Where n is the number of study samples

2. To convert into metric r, we have: $r = \sqrt{\frac{t^2}{t^2 + df}}$

Where df is the degree of freedom

3. To convert ANOVA (F) into r, according to $t^2 = t$, we give: $r = \sqrt{\frac{F}{F + df}}$

At the end, the mean effect size was calculated by the following formula:

$$\bar{r} = \frac{\sum_{i=r}^{n} r_i n_i}{\sum_{i=1}^{n} n_i}$$

Where ni is the number of subjects in each independent study and ri is the correlation coefficient in each independent study.[30]

It should be noted that effect size is the most important keyword in meta-analysis. In Statistical Power Analysis for behavioral sciences, Cohen defines the effect size as: without intention to express the concept of causality, it is more convenient to apply "effect size" into one of these concepts: the extent to which the desired phenomenon is in population or the extent to which the null hypothesis is false. The higher the value, the more the incidence rate of the study phenomenon will be in the population.[30] So, the effect size can be conceptualized as a standardized difference. In the simplest form, effect size is the mean difference between groups in standard score form i.e. the ratio of the difference between the means to the standard deviation. This concept is derived from a school of methodology named Meta-analysis, which was developed by Glass. [31]

There are various methods to calculate the effect size. The most common measures of effect size are the differences of standard of mean and correlations. Wolff [32] states that all meta-analyses can be done based on calculating the correlation coefficient as an index of the effect size. He believes that if in the conducted studies, parameters of X^2, t, F or Z are reported, the effect size can be estimated from them.[32] Accordingly, the effect size represents the rate or degree of presence of a certain phenomenon in the population.

After calculating the effect size obtained by Hedges method, to interpret the results, Cohen's approach was used: The larger the effect size, the greater the presence of the degree of the phenomenon. According to the interpretation of Cohen's effect size, if r=0.1 and d=0.2, the effect size is small, if r=0.3 and d=0.5, the effect size is medium and if r=0.5 and d=0.8, the effect size is large. [33] All of the statistical analysis were carried out in $STATA_{12}$ Statistical software and the ultimate model was designed by E-draw $Max_{6.8}$ software.

RESULTS

In this study, a total of 164 studies were investigated in the field of information and communication technology acceptance with the same methodology and survey instrument. These studies were classified to do the meta-analysis in the level of subgroups in various views. These subgroups included classification of the study samples into the public, students and organization's staff and classification of thematic areas into information and communication technologies in general, e-learning and e-government. Table 2 shows information on the status of studies selected in terms of the above classification.

The main objective of the present study was to determine the variables affecting technology acceptance and to measure the effect size of main and external variables affecting Davis's technology acceptance model. Accordingly, the research questions were formulated as follow:

The first question was related to determining main and external variables in technology acceptance based on Davis's

Table 2: Classifying the selected studies for meta-analysis based on the thematic area and study population.

Subject field of studies	Number of studies	studied population	Number of studies
General information technology	111	The public	94
e-government	31	Organization's staff	37
e-learning	22	Students	33
Total	164	Total	164

Table 3: Results of the tests of means difference and homogeneity rate of studies using Q-test based on examined twenty-one-dimensional variables.

Items	Random effect		P-value	Q-test	Study	Sample	Moment-based estimate of between studies variance
	Mean	95% CI					
Usefulness	3.816	3.386 -3.945	0.000	0.000	160	44244	0.682
Ease of Use	3.857	3.698 – 4.015	0.000	0.000	153	42677	0.995
Intention	3.748	3.530 – 3.966	0.000	0.000	90	28348	1.075
Attitude	3.731	3.534 – 3.928	0.000	0.000	102	3134	1.024
BI	3.609	3.385 – 3.832	0.000	0.000	76	23253	0.969
SubjectNorm	3.197	2.739 – 3.655	0.000	0.000	36	9091	1.939
Skill	3.574	3.326 – 3.821	0.000	0.000	59	19680	0.918
Bihavior Con	3.283	2.976 – 3.591	0.000	0.000	27	10099	0.661
ComAnxiety	3.284	2.920 – 3.649	0.000	0.000	33	9680	1.100
ComSeEffi	3.209	2.773 – 3.644	0.000	0.000	24	6248	1.154
Social	3.829	3.455 – 4.202	0.000	0.000	36	9646	1.257
OrgSu	3.549	3.153 – 3.945	0.000	0.000	60	16731	2.417
Compatibility	3.311	2.898 – 3.724	0.000	0.000	30	10409	1.292
SystemQ	3.166	2.808 – 3.523	0.000	0.000	43	14625	1.414
Information Q	3.369	3.121 – 3.618	0.000	0.000	74	23909	1.145
Availability	3.179	2.308 – 4.049	0.000	0.000	23	8028	4.493
Trust	3.439	3.145 – 3.732	0.000	0.000	43	14399	0.960
Innovation	3.587	3.275 – 3.898	0.000	0.000	19	6941	0.474
Usage	3.369	3.035 – 3.703	0.000	0.000	41	11596	1.178
Job Relevance	3.285	3.016 – 3.554	0.000	0.000	52	16656	0.928
Enjoyment	3.547	3.220 – 3.874	0.000	0.000	40	15180	0.952

model. It should be noted that in meta-analysis, the criterion to judge the variables in a model is based on the significance of the values measured in the studied research according to the related test (in this study, differences of means). Accordingly, means and standard errors of examined twenty-one-dimensional variables were collected in each study. By doing means difference test, it was determined that all variables examined in studies were significant and effective in terms of different users. But, the remarkable points about the value of each variable were: 1- the number of studies carried out on the variable and 2- the number of samples examined in the sum of studies. Table 3 shows the results of means difference test based on variables, significance level, the number of investigated studies and samples and the homogeneity rate of studies based on Q-test. It is worth mentioning that regardless of the classifications of studies, the data in the following table are based on Table 1 (subgroup) and results have been presented in general.

According to Table 3, variables of perceived usefulness, perceived ease of use, behavior intention and attitude have the highest mean, respectively. All four variables belong to the main variables of Davis's technology acceptance model. Another point is that the mean obtained in the table is studied based on the number of examined studies and samples. As it can be observed, the main variables of Davis's model have been investigated in most studies while the external variables have been examined in only a limited number of studies.

The second, third and fourth questions determine the main and external variables of the model affecting Davis's Technology Acceptance Model based on the type of users with regard to the study population (the public, students and organization's staff). The findings indicated that all means of twenty-one-

Table 4: Results of means differences and homogeneity tests in studies (Q-test) based on the sample of the public.

Items	Random effect		*P*-value	Q-test	Study	Sample	Moment-based estimate of between studies variance
	Mean	95% CI					
Usefulness (public)	3.799	3.596 – 4.002	0.000	0.000	73	23591	0.765
Ease of Use (public)	3.894	3.624 – 4.163	0.000	0.000	66	21330	1.230
Intention (public)	3.671	3.249 – 4.094	0.000	0.000	42	15630	1.943
Attitude (public)	3.715	3.475 – 3.955	0.000	0.000	49	17060	0.724
BI (public)	3.583	3.258 – 3.907	0.000	0.000	35	11914	0.943
Subject Norm (public)	3.226	2.522 – 3.930	0.000	0.000	13	4545	1.671
Skill (public)	3.332	2.940 – 3.724	0.000	0.000	30	11187	1.178
Bihavior Con (public)	3.335	2.923 – 3.746	0.000	0.000	15	5680	0.655
Com Anxiety (public)	3.674	3.174 – 4.173	0.000	0.000	13	3736	0.822
ComSeEffi (public)	3.571	3.066 – 4.075	0.000	0.000	8	2316	0.524
Social (public)	3.664	3.295 – 4.033	0.000	0.000	17	4112	0.592
OrgSu (public)	3.385	2.529 – 4.242	0.000	0.000	23	5729	4.381
Compatibility (public)	3.312	2.861 – 3.764	0.000	0.000	11	2838	0.567
SystemQ (public)	2.926	2.392 – 3.460	0.000	0.000	22	8154	1.628
Information Q (public)	3.337	2.935 – 3.740	0.000	0.000	35	12830	1.424
Avalibility (public)	2.972	2.407 – 3.538	0.000	0.000	9	2397	0.744
Trust (public)	3.517	3.241 – 3.794	0.000	0.000	28	4702	0.549
Innovation (public)	3.503	2.960 – 4.046	0.000	0.000	7	480	0.527
Usage (public)	3.326	2.895 – 3.758	0.000	0.000	16	1827	0.765
Job Relevance (public)	3.314	2.949 – 3.678	0.000	0.000	24	3749	0.797
Enjoyment (public)	3.733	3.322 – 4.144	0.000	0.000	20	3671	0.779

dimensional study variables are significant in terms of the impact on technology model. The important point is to change ranking variables compared to Table 2 because of the investigated studies in the subgroup of samples. Table 4, 5 and 6 show the results of means differences and homogeny tests in studies based on the subgroup of the sample.

The fifth, sixth and seventh questions examined the main and secondary variables affecting Davis's model based on the subgroup of the area of information technology surveyed in studies. The results indicated that based on this subgroup, all variables are significant only by changing their rank in the table in terms of the impact on Davis's technology model. Tables 7, 8 and 9 show the results of mean difference and homogeny tests.

The eighth question studies the effect size of each variable in the level of analytic data of the studies under examination.

At this stage, values of various tests in various studies for measuring the significant rate of twenty-one-dimensional study variables changed to index r according to the formula provided in the methodology. Finally, by calculating $\bar{r}$, the effect size of the study variables was calculated (This is discussed in the materials and method part). Given this and according to the metric approach of Cohen, the results showed that all main variables in Davis's Technology Acceptance Model including perceived usefulness, perceived ease of use, attitude, usage and intention have high correlation with each other. In terms of external variables, after calculating $\bar{r}$, it was determined that there was a weak correlation between variables of innovation, attitude and usage. There is also a medium correlation between computer anxiety as an external variable and perceived ease of use and perceived usefulness as the main variables. On the other hand, there are weak and medium correlation between enjoyment and perceived ease of use and the same variable and perceived usefulness, respectively. Between the other variables, there is a high correlation between main and secondary variables. Table 8 shows correlations of all twenty-one-dimensional variables with each other in studied researches. It should be noted that the sign *** indicates high correlation, **medium correlation and *weak correlation. (Table 10)

Thus, by identifying the external variables of Davis's model, based on the variables examined in various studies, the schema of this model can be drawn based on the behavior of samples or users on the acceptance or rejection of studied technologies (Figure 1). Given that this model was obtained based on the outcome of results of studies conducted in the area of technology acceptance and by meta-analysis methodology, the present model was called meta-analysis model by the authors.

Table 5: Results of means differences and homogeneity tests in studies (Q-test) based on the sample of students.

Items	Random effect		P-value	Q-test	Study	Sample	Moment-based estimate of between studies variance
	Mean	95% CI					
Usefulness (student)	3.961	3.701 – 4.221	0.000	0.000	33	2058	0.627
Ease of Use (student)	3.951	3.626 – 4.275	0.000	0.000	33	1909	1.006
Intention (student)	4.004	3.738 – 4.269	0.000	0.000	18	604	0.324
Attitude (student)	3.814	3.399 – 4.228	0.000	0.000	25	870	1.111
BI (student)	3.654	2.930 – 4.378	0.000	0.000	16	611	2.177
Subject Norm (student)	3.687	2.831 – 4.543	0.000	0.000	6	965	1.134
Skill (student)	3.774	3.319 – 4.229	0.000	0.000	13	4482	0.693
BihaviorCon (student)	2.565	2.320 – 2.810	0.000	0.000	2	1253	0.029
ComAnxiety (student)	3.237	2.490 – 3.983	0.000	0.000	7	2059	0.984
ComSeEffi (student)	3.511	2.769 – 4.254	0.000	0.000	8	1613	1.140
Social(student)	3.621	2.679 – 4.564	0.000	0.000	7	2221	1.448
OrgSu (student)	3.646	3.120 – 4.172	0.000	0.000	8	2326	5.21
Compatibility (student)	3.654	2.369 – 4.940	0.000	0.000	4	898	1.717
SystemQ (student)	3.708	3.086 – 4.330	0.000	0.000	8	2818	0.801
Information Q (student)	3.587	2.929 – 4.246	0.000	0.000	12	3524	1.159
Availability (student)	3.647	2.816 – 4.476	0.000	0.000	7	2623	1.247
Trust (student)	3.293	2.663 – 3.923	0.000	0.000	6	2088	0.616
Innovation (student)	2.785	1.246 – 4.323	0.000	0.000	2	413	1.227
Usage (student)	3.368	2.909 – 3.827	0.000	0.000	16	3532	0.862
Job Relevance (student)	3.431	2.806 – 4.055	0.000	0.000	10	3668	0.998
Enjoyment (student)	3.568	3.192 – 3.944	0.000	0.000	11	2804	0.344

Table 6: Results of means differences and homogeneity tests in studies (Q-test) based on the sample of staff in organizations.

Items	Random effect		P-value	Q-test	Study	Sample	Moment-based estimate of between studies variance
	Mean	95% CI					
Usefulness (Staff)	3.600	3.346 – 3.854	0.000	0.000	37	9576	0.631
Ease of Use (Staff)	3.720	3.485 – 3.954	0.000	0.000	37	10997	0.551
Intention (Staff)	3.686	3.370 – 4.001	0.000	0.000	22	7099	0.549
Attitude (Staff)	3.580	3.075 – 4.085	0.000	0.000	21	6458	1.388
BI (Staff)	3.460	3.026 – 3.895	0.000	0.000	18	5515	0.849
Subject Nor (Staff)m	2.904	1.814 – 3.994	0.000	0.000	12	2866	3.638
Skill (Staff)	4.037	3.662 – 4.421	0.000	0.000	18	3588	0.441
Bihavior Con (Staff)	3.377	2.826 – 3.928	0.000	0.000	9	2927	0.709
Com Anxiety (Staff)	2.939	2.066 – 3.813	0.000	0.000	10	2980	1.884
Com SeEffi (Staff)	2.227	0.394 – 4.060	0.053	0.017	2	740	1.381
Social (Staff)	4.267	4.041 – 4.793	0.000	0.000	23	3141	0.128
OrgSu (Staff)	3.785	3.617 – 3.954	0.000	0.000	22	7071	0.152
Compatibility (Staff)	3.241	2.694 – 3.788	0.000	0.000	13	6336	0.943
System (Staff)	3.292	2.641 – 3.943	0.000	0.000	12	3481	1.272
InfomationQ (Staff)	3.285	2.965 – 3.604	0.000	0.000	24	6905	0.616
Avalibility (Staff)	2.952	0.957 – 4.948	0.000	0.000	7	3008	7.123
Trust (Staff)	3.433	2.742 – 4.124	0.000	0.000	8	3736	0.990
Innovation (Staff)	3.790	3.323 – 4.257	0.000	0.000	3	2808	0.169
Usage (Staff)	3.444	2.535 – 4.352	0.000	0.000	9	2568	1.925
Job Relevance (Staff)	3.296	2.321 – 4.272	0.000	0.000	5	5426	0.986
Enjoyment (Staff)	3.037	1.949 – 4.126	0.000	0.000	8	3006	2.064

Table 7: Results of means differences and homogeneity tests in studies (Q-test) based on the area of ICT in general.

Items	Random effect		P-value	Q-test	Study	Sample	Moment-based estimate of between studies variance
	Mean	95% CI					
Usefulness (IT)	3.820	3.666 – 3.973	0.000	0.000	97	25698	0.541
Ease of Use (IT)	3.875	3.679 – 4.072	0.000	0.000	93	25656	0.877
Intention (IT)	3.784	3.577 – 3.990	0.000	0.000	41	14075	0.441
Attitude (IT)	3.802	3.606 – 3.999	0.000	0.000	60	18792	0.597
BI(IT)	3.614	3.269 – 3.960	0.000	0.000	39	12688	1.193
S ubject Norm (IT)	3.567	2.943 – 4.191	0.000	0.000	12	5993	1.159
Skill (IT)	3.588	3.251 – 3.924	0.000	0.000	32	11736	0.907
BihaviorCon(IT)	3.386	3.062 – 3.710	0.000	0.000	18	7834	0.486
ComAnxiety (IT)	3.520	3.016 – 4.024	0.000	0.000	17	5226	1.068
ComSeEffi (IT)	3.198	2.687 – 3.708	0.000	0.000	11	3374	0.701
Social (IT)	3.641	3.049 – 4.232	0.000	0.000	16	4234	1.417
Org Su (IT)	3.754	3.472 – 4.035	0.000	0.000	30	9250	0.586
Compatibility (IT)	3.281	2.749 – 3.813	0.000	0.000	19	6910	1.357
System (IT)	3.149	2.698 – 3.601	0.000	0.000	26	8673	1.351
Information (IT)	3.459	3.059 – 3.859	0.000	0.000	41	13776	1.655
Availability (IT)	3.090	2.597 – 3.583	0.000	0.000	15	6120	0.913
Trust (IT)	3.429	3.009 – 3.849	0.000	0.000	21	7803	0.957
Innovation (IT)	3.455	2.965 – 3.944	0.000	0.000	10	3792	0.614
Usage (IT)	3.320	2.859 – 3.780	0.000	0.000	22	5668	1.203
Job Relevance (IT)	3.237	2.852 – 3.622	0.000	0.000	31	10940	1.134
Enjoyment (IT)	3.216	2.805 – 3.627	0.000	0.000	28	11277	1.012

Table 8: Results of means differences and homogeneity tests in studies (Q-test) based on the area of E-government.

Items	Random effect		P-value	Q-test	Study	Sample	Moment-based estimate of between studies variance
	Mean	95% CI					
Usefulness (E government)	4.058	2.949 – 5.167	0.000	0.000	7	1484	2.236
Ease of Use (E government)	3.926	2.954 – 4.897	0.000	0.000	9	2173	2.204
Intention (E government)	3.060	2.096 – 4.025	0.000	0.000	6	1771	1.447
Attitude (E government)	3.695	3.180 – 4.209	0.000	0.000	9	2309	0.612
BI (E government)	3.994	3.844 – 4.145	0.949	0.000	2	495	0.000
Subject Norm (E government)	2.200	1.965 – 2.435	0.000	0.000	2	108	0.000
Skill (E government)	3.031	2.408 – 3.654	0.000	0.000	5	959	0.499
Behavior Con (E government)	3.148	2.464 – 3.832	0.000	0.000	3	687	0.363
Com Anxiety (E government)	2.724	1.710 – 3.739	0.000	0.000	3	329	0.712
ComSeEffi (E government)	0.000	0.000	0.000	0.000	0	0	0.000
Social (E government)	3.878	3.192 – 4.563	0.000	0.000	3	619	0.356
Orbs (E government)	3.627	2.715 – 4.538	0.000	0.000	2	470	0.427
Compatibility (E government)	3.580	2.228 – 4.932	0.000	0.000	1	108	0
System (E government)	3.643	3.059 – 4.226	0.000	0.000	3	382	0.256
Information (E government)	2.334	1.688 – 2.981	0.000	0.000	2	360	0.213
Availability (E government)	4.720	4.465 – 4.975	0.000	0.000	6	61	0.000
Trust (E government)	4.195	3.759 - 4.631	0.000	0.000	5	1562	0.241
Innovation (E government)	3.757	3.287 – 4.227	0.000	0.000	2	279	0.110
Usage (E government)	2.606	1.393 – 3.818	0.000	0.000	5	949	1.896
Job Relevance (E government)	0.000	0.000	0.000	0.000	0	0	0.000
Enjoyment (E government)	3.100	2.982 – 3.218	0.000	0.000	1	111	0.000

Table 9: Results of means differences and homogeneity tests in studies (Q-test) based on the area of E-Learning.

Items	Random effect		P-value	Q-test	Study	Sample	Moment-based estimate of between studies variance
	Mean	95% CI					
Usefulness(education)	4.131	3.918 – 4.343	0.000	0.000	15	3628	0.172
Ease of Use(education)	3.772	3.515 – 4.028	0.000	0.000	13	2973	0.211
Intention(education)	3.836	3.504 – 4.167	0.000	0.000	11	2724	0.308
Attitude(education)	3.907	3.440 – 4.374	0.000	0.000	9	2442	0.503
BI(education)	4.233	3.966 – 4.499	0.000	0.000	10	3367	0.182
SubjectNorm(education)	3.456	2.809 – 4.103	0.000	0.000	7	1090	0.752
Skill(education)	3.434	3.012 – 3.855	0.000	0.000	8	2271	0.361
BihaviorCon(education)	0.000	0.000	0.000	0.000	0	0	0.000
ComAnxiety(education)	2.883	2.302 – 3.464	0.000	0.000	6	2279	0.515
ComSeEffi(education)	3.071	1.806 – 4.366	0.000	0.000	7	1227	2.907
Social(education)	3.968	3.423 – 4.512	0.000	0.000	4	1535	0.301
OrgSu(education)	3.968	3.443 – 4.493	0.000	0.000	4	2514	0.282
Compatibility(education)	3.292	2.116 – 4.469	0.000	0.000	3	889	1.074
system(education)	3.438	2.566 – 4.311	0.000	0.000	3	691	0.590
infomationQ(education)	3.826	3.510 – 4.142	0.000	0.000	7	2465	0.178
Avalibility(education)	3.990	2.618 – 5.362	0.000	0.000	2	720	0.976
Trust(education)	2.260	2.201 – 2.319	0.000	0.000	1	207	0.000
Innovation(education)	3.280	3.182 – 3.378	0.000	0.000	1	207	0.000
Usage(education)	2.885	1.558 – 4.212	0.000	0.000	4	1436	1.810
Jobrelevance (education)	3.557	2.607 – 4.506	0.000	0.000	6	1561	1.289
Enjoyment (education)	4.369	3.722 – 5.016	0.000	0.000	2	586	0.214

It should be mentioned that the schema of the weak, medium and strong correlations have been shown with signs of; and respectively. (Figure 2)

DISCUSSION

In fact, meta-analysis is the analysis of analyses or statistical analysis of a set of findings in order to combine previous findings.[32] In this study, studies on technology acceptance in three citation databases of ISI, Scopus and ISC were selected and meta-analysis was done based on criteria presented in methodology. Also, in order to achieve the maximum articles, databases including ACM, Science Direct, IEE Explorer and search engines such as Google and Yahoo were searched. It can also be stated that the main objective of the study was defined as to provide the outcome of results and findings of previous studies in this area using statistical methods. Now, the main benefit of such studies is with no doubt to provide a documentary insight of the status of research topics on specific areas. Since the acceptance of new technologies, especially information and communication technologies among population, organizations, etc. are wide spread, the area of technology acceptance is a good opportunity to research for researchers. Within the years when this area has been studied, a lot of articles have been published with different applications in terms of the population and studied various applications of information communication technology (ICT). The results of this study are in line with those studies and provide a unified outcome of their results.

The study findings showed that 21 main and external variables (4 main variables and 17 external variables) are the most important factors affecting the acceptance of technologies researched in the studies investigated by various statistical populations. According to the obtained means, among from other factors, the variable of perceived ease of use with the highest mean i.e. 3.875 has had the greatest impact on the users at different classes and the variable of system quality with the mean of 3.166 has had the least impact on the users in technology acceptance. The noteworthy point is that the above results were presented regardless of the number of studies, the type of population and the number of samples. For example, variables of perceived ease of use and perceived usefulness being at first and second ranks have been examined in 160 and 153 studies out of a total of 164 studies, respectively. Although the variable of innovation which is in the seventh rank, it has been investigated only in 19 studies. Another issue is the number of examined samples. The number of samples will undoubtedly have a high effect on the validity and reliability of the effect of variables, it should be noted that

Table 10: Report of mean of correlation (mean of effect size) between main and broad variables in the technology acceptance model

	Usefulness	Ease of Use	Intention	Attitude	BI	Subject Norm	Skill	Bihavior Con	ComAnxiety	ComSeEffi	Social	OrgSu	Compatibility	SystemQ	InfomationQ	Availability	Trust	Innovation	Usage	Job relevance	Enjoyment
Usefulness	1																				
Ease of Use	.86***	1																			
Intention	.49**	.39**	1																		
Attitude	.48**	.43**	.44***	1																	
BI	.52**	.35**	-	.50**	1																
Subject Norm	.33**	.34**	.80***	.41**	.20*	1															
Skill	.14*	.33**	.22*	.22*	-	-	1														
Bihavior Con	.27*	.17*	.49**	.23*	.38**	.15*	.24*	1													
ComAnxiety	.18*	.30*	-	.18*	.16*	.36**	-	-	1												
ComSeEffi	.30**	.34**	.45**	.63**	.16*	.59**	.09*	-	.06*	1											
Social	.29*	.23*	-	.59**	-	-	-	-	-	-	1										
OrgSu	.23*	.25*	.24*	.16*	.11*	.24*	.16*	-	.22*	.11	-	1									
Compatibility	.44**	.13*	.57**	-	.49**	.05*		.38**	.14*	-	-	-	1								
SystemQ	.33**	.36**	.38**	-	.05*	.64**	.35**		.07*	.07*	.64**	.20*		1							
InfomationQ	.41**	.42**	.43**	.48**	.30**	.76***	.29*	.26*	-	.66**	-	.24*	.44**	.55**	1						
Availability	.08*	-	-	-	.14*	-	-	-	-	-	-	-	-	-	-	1					
Trust	.37**	.33**	.29*	.27*	.27*	-	-	.53**	-	.14*	-	-	.22*	-	-	.07*	1				
Innovation	.39**	.27*	.33**	.26*	-	-*	-		-	-	-	-	.49**	.14*	-	.06*	.03*	1			
Usage	.44**	.40**	.45**	.27*	.40**	.07	.34**	.17*	.18*	.07*	-	.34**	-	.24*	.22*	.35**	.29*	.15*	1		
Job Relevance	.19*	.17*	-	-	.37**	-	.25*	-	-	-	-	.33**	-	.25*	-	-	-	-	.32**	1	
Enjoyment	.42**	.45**	.56**	.61**	-	.72***	.08*	-	.18*	.46**	.08*	.16*	-	.66**	.62**	-	.20*	-	.28	-	1

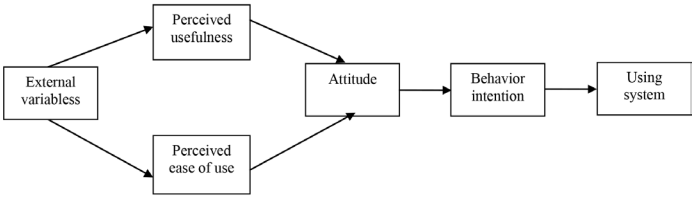

Figure 1: Schema of Davis's technology acceptance model.[1]

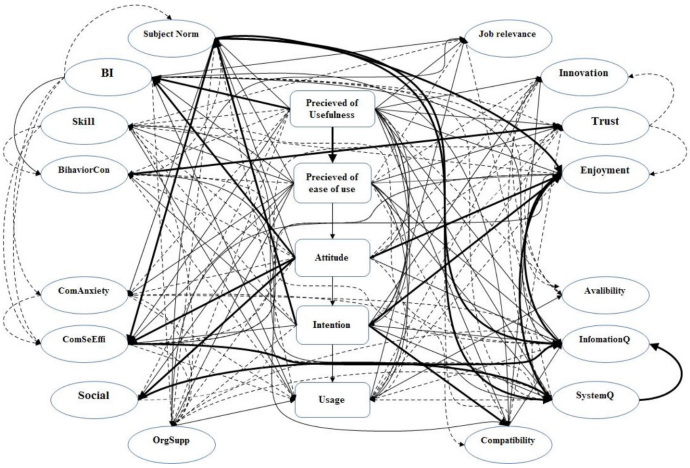

Figure 2: The schema of the weak, medium and strong correlations between main and broad variables in technology acceptance model.

perceived usefulness; perceived ease of use; intention and attitude had been investigated in over 80% of all samples in the studies (45679). While variables of Computer Self Efficacy, innovation, availability and Subject Norm have only been in 16.5% of the total samples and on average in 25 studies of 164 reviewed studies. In the same vein, other variables are given in Table 2.

In the second, third and fourth questions of the study, means difference were studied similar to the previous stage at the level of subgroup of types of sample (the public, organizations' staff and students). A total of 94, 37 and 33 studies were reported with the subgroups of the public, organizations' staff and students, respectively. All 21 variables identified in all studies have also been examined in the above subgroups. The rank of studied variables was almost the same in the overall analysis (i.e. regardless of the subgroups); however, some significant changes are observed. For example, in the subgroup of studies whose samples were the public, enjoyment was at the third rank and even higher than two main variables of Davis's model (attitude and intention). However, this variable has the rank of 14 and 17 in subgroups of students and organizations' staff, respectively. It seems that the enjoyment of applying new technologies is among from factors influencing the public. In subgroups whose studied samples were students, there is no much change in terms of ranking. The only noteworthy point is that some variables such as innovation, Behavior Control and compatibility have been examined in a very small number of Studies (7.8%), (Table 4). Also, in the studies whose studied samples were organizations' staff, the noteworthy point is to increase variables of social acceptability and skill being at the first and second ranks and even before the main variables of Davis's model. Perhaps, this factor can be explained in a way that given that one of the major criteria applying organizations' individuals is to have skill in the desired field, this factor is considered as one of the main variables for staff and it also appears that organizations' staff tend to accept technologies more which causes to increase their acceptability in the organizational environment (Table 5).

On studies whose examined population are organizations' staff including 6 of the 25 studies, the situation is different. In such studies, perceived usefulness, attitude and perceived ease of use used in most studies (Table 5) have ranks of 2 to 4 in the Table in terms of the mean value. Other variables have been examined in one of 6 studies and the number of its samples would naturally be too small. It seems that researches done in organizations by researchers have been solely based on the main variables of Davis' model. Perhaps, the analysis on this issue is that external variables such as computer anxiety, skill, enjoyment etc. are not considered as effective or risk factors on the organizations' space defined and consolidated for their staff that has caused the lack of reporting such variables in such studies.

In questions 5, 6 and 7, the test of means difference was implemented at the subgroup level of areas of information and communication technology. Accordingly, studies done generally in the field of information and communication technologies included 111 studies. In this subgroup, four main variables of Davis's model have the highest frequency in the number of studies and naturally in the number of the samples. It seems that when researchers examine general technologies such as computers, the Internet etc., they study most of the main variables and measure the characteristics of the desired population based on the above variables.

On studies in the field of e-government including a total of 31 researches, the remarkable note is that variables of availability and reliability to technology are at the first rank with means of 4.720 and 4.195, respectively. For accepting technologies whose custodians are often exclusive (such as banks and communication terminal of government with people), it can be stated that users consider its availability as the most important factor by considering that in entering into electronic systems such as electronic banking or interacting with organizations according to providing the personal, financial information, etc. users consider the trust as an important variable because in many cases, the issue of confidentiality of information will cause the lack of trust and eventually the lack of acceptance. These results are consistent with the results of Gefen's study in the field of electronic commerce.[6] and his other study on

information systems.[34] In other words, it can be stated that users consider the main variables of Davies' model such as perceived ease of use; perceived usefulness; attitude and behavior intention as effective, if and only if the discussed technologies are first available and then reliable. Another point is that other variables such as Computer Self Efficacy and Job relevance were not generally investigated in there searches whose technology subgroup was e-government or not received a rank by the users. Also, variables such as enjoyment and compatibility have been examined in only one study. The rationale behind the issue is that the acceptance of technologies that people have to some extent accept (to do their daily tasks) is principally not transferred from variables such as Computer Self Efficacy and Job relevance or such variables because users must use the amount of technologies related to this group (e-government) with any degree of familiarity with computer or any job.

Studies of the subgroup of e-learning have been addressed in only 22 of 164 studies. In this subgroup, like most previous analyses, the main variables of Davis's model have received the highest value of the means. Just the variable of Behavior Control has been reported in no studies of this subgroup. The interesting point in this subgroup is the distribution of variables in two widely- and least used groups. First, out of 22 studies, the maximum number of times a variable was examined does not exceed 15 ones. Second, it seems that variables considered important in the viewpoint of researchers and research subjects do not exceed 9. This means that 9 variables have been studied in at least one third of studies related to this subgroup (22 studies).

Question eight aimed at calculating the effect sizes of variables and factors affecting the acceptance of Information Communication Technology (ICT). As it was mentioned in the methodology, to calculate the effect size, the significance level of tests performed in studies is required. Also, all answers of tests must be converted into a metric unit and in this study, since most of studies were of correlational type, Hedges approach was used. After calculating $\bar{r}$, the results showed that in Davis's model, all main variables had high effect size; therefore, a very high correlation is established between these variables. It should be noted that in calculating $\bar{r}$, as it came from its formula, the number of samples affects the total studies in which the binary correlation of twenty-one-dimensional variables has been calculated. While most effect sizes between external variables with each other are moderate and weak (Table 9), it seems that based on characteristics of samples (the public, students and organizations' staff) and the field of information technology and communications (ICT in general, e-government and e-learning), the external variables examined by researcher, the different significance rate, they have been resulted from subgroups.

An obvious example was the importance of variables of accessibility and trust which had manifested in studies conducted on the public and e-government. In the studies done by King and Hu[8] and Sledgianowski and Kulviwat,[9] similar results were obtained. Another point is related to the column in the table of the level of homogeneity in studies. The level of homogeneity in studies depends on factors including the type of samples, number of studied samples, number of meta-analysis studies and type of measurement instruments applied in the studies. Although it is better that in meta-analysis, studies be somewhat in homogeneity with Q-test, in this study, considering that there are most factors affecting heterogeneity in the studies, we observe their heterogeneity. In the study done by King and Hu,[8] given that all examined variables were only 4 variables and included all research samples of students, all 23 studies were homogeneous. On the other hand, in meta-analysis performed by Sumak *et al.*[14] increasing the number of studies (42 studies) and having various samples (students, organizations' staff and experts) caused heterogeneity among studies.

CONCLUSION

According to the above results and analyses, it can be stated that the main variables in Davis's technology acceptance model including perceived ease of use, perceived usefulness, attitudes and (usage) are among important variables influencing the rate of technology acceptance. Furthermore, the components of Davis's model can be regarded as the components of an ideal model.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUMMARY

The main object is to identify the factors which cause the acceptance or rejection of technology by users. Studies in the field of information technology adoption, seeks to identify the factors that lead to technology adoption is dumped by people. The method was meta-analysis. All studies done from three citation databases of ISI, Scopus and ISC. The data analysis with Hedges approach. Also, Cohen approach was used for their interpretation. The results shown, twenty-one-dimensional variables with different values are effective in the technology acceptance. Given that all main variables in Davies model (TAM) had high means and high effect size.

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