COLLNET Journal of Scientometrics and Information Management
ISSN : 0973 – 7766 (Print) 2168 – 930X (Online)
Vol. 17(1) June 2023, pp. 39–59
DOI : 10.47974/CJSIM-2022-0008

The mainstream and pattern detection of e-learning acceptance research : Insights from a bibliometric analysis (2010-2021)

Ahmet Ayaz
Ozcan Ozyurt
Fatih Gurcan

Ahmet Ayaz *
Karadeniz Technical University
Digital Transformation Office
Trabzon
Türkiye
* ahmetayaz@ktu.edu.tr

Ozcan Ozyurt †
Department of Software Engineering
Faculty of Technology
Karadeniz Technical University Trabzon
Türkiye
† oozyurt@ktu.edu.tr

Fatih Gurcan §
Department of Management Information Systems
Faculty of Economics and Administrarive Sciences
Karadeniz Technical University
Trabzon
Türkiye
† oozyurt@ktu.edu.tr

* (Corresponding Author)

Electronic learning has begun to attract the attention with Covid-19 pandemic. In this regard, it will be timely and critical to conduct a bibliometric analysis to identify developments in e-learning adoption research and to guide future research. In this study, a total of 1251 studies about the adoption of e-learning conducted in the last eleven years as of June 2021, reached with the scanning of the Web of Science (WoS) database, were identified and bibliometric analysis was performed on these studies. VOSviewer software was used in order to conduct bibliometric mapping, and Harzing's Publish and Perish software was used to calculate the h-index. According to the bibliometric analysis, the research on the adoption of e-learning is a field that has grown and developed exponentially since 2010. While Taiwan draws attention as the most contributing country in the e-learning adoption literature, National Central University was the contributing institution. According to the keyword co-occurrence analysis, in terms of e-learning adoption studies, the keywords such as mobile learning, blended learning, higher education, TAM, UTAUT and structural equation model came to the fore. In recent years, covid-19, mobile technologies, flipped classrooms, social media, MOOC, PLS-SEM, and UTAUT-2 stand out as trending topics. As a result, the findings of the study provide a comprehensive description of the field and provide important, enlightening and stimulating information for researchers who are willing to conduct studies on e-learning adoption and will be willing to do so in the future.

Keywords: *E-learning, Technology acceptance, Technology adoption, Bibliometric analysis, Bibliometric mapping.*

Introduction

Electronic learning (E-Learning) is an interdisciplinary field that covers a wide range of topics. In this context, the concepts of online learning, distance learning, and web/internet-based education/instruction/training, which have the same meaning as e-learning and are often used interchangeably, come to the fore (Gurcan et. al., 2021). As a result of the constant advancement of technology, there is no universally accepted definition of e-learning (Al-Fraihat et. al., 2020). E-learning is considered as learning by using information and communication technologies (Kuliya & Usman, 2021), it is frequently defined as the incorporation of new technology into teaching and learning activities (Al-Rahmi et. al., 2018; Wolfe & Cedillos, 2015). According to Cheon et. al., (2012), E-learning provides a good platform for adaptive learning, supports a range of learning paths, and stimulates the use of information technology. In general, e-learning can offer learning materials quickly without time or space limitations and enable students to choose different learning materials according to their level, interests and needs. Therefore, examining the factors that determine the use of e-learning will make an undeniable contribution to the development of e-learning systems (Li et. al., 2021).

Studies on the acceptance of e-learning mainly focus on students. Researchers generally try to explain the factors affecting the students' acceptance of e-learning technology (Šumak et. al., 2011). Most e-learning adoption studies employ well-known and current acceptance theories and methodologies created and enhanced over the last two decades. The study by Šumak et. al., (2011) revealed that the Technology Acceptance Model (TAM) is the most widely applied basic theory in adopting online learning. TAM was developed by Davis (1989) to evaluate the success of information systems. It is the most extensively utilized theory for determining new technology's success in adoption and utilization (Surendran, 2013). Researchers have mainly explained a user's intentions to use an e-learning technology by using or advancing TAM. TAM was critically examined by Legris et. al., (2003), who stated that other variables should be incorporated in order to comprehend the aspects influencing technology adoption fully. Also, the Theory of Reasoned Action– TRA (Ajzen & Fishbein, 1980), the Theory of Planned Behavior – TPB (Icek, 1991), the Information Systems Success Model – ISSM (DeLone & McLean, 1992), Unified Technology Acceptance and Use Theory – (UTAUT) (Venkatesh et. al., 2003) and the Extended Unified Technology Acceptance and Use Theory – UTAUT-2 (Venkatesh et. al., 2012) stand out as the prominent model/theory applied in the field of e-learning. Many studies have been conducted on the adoption of e-learning from the past to the present. TAM, TPB, ISSM, UTAUT and UTAUT-2 models were generally used in these studies (Abbad et. al., 2009; Abdullah & Ward, 2016; Baki et. al., 2021; Mohammadi et. al., 2021; Okazaki, 2012; Rizun & Strzelecki, 2020; Salloum et. al., 2019; Tan, 2013; Tarhini et. al., 2014).

The literature lacks of detailed studies that reveal a systematic review or meta-analysis of the studies on e-learning adoption. Although studies reveal the general trend of e-learning from a bibliometric point of view (Hung, 2012), there are limited studies on the adoption of e-learning. In Taylor, (2001) stated that much can be learned by analyzing research presented in scientific publications from a bibliometric point of view.

A remarkable study in the literature was carried out by Mashroofa et. al., (2019). The study, which performed bibliometric analysis on studies on the adoption of e-learning, drew attention to this area. Using the search term "e-learning adoption theory" in the Web of Science and Scopus databases, they discovered the research trend on e-learning adoption theory between 2000 and 2019. Another important study aimed to examine academic research in the field of e-learning in Iran using network analysis and scientific mapping methods (Negahban, 2021). The data used in the article were collected from electronic databases of universities operating in Iran. The results of the analysis revealed that research in the field of e-learning has increased over time and the most frequently used keywords are "e-learning", "computer assisted learning" and "distance education". In addition, it was determined that e-learning research in Iran is conducted with an interdisciplinary approach and the most frequently researched fields are educational technologies and computer sciences. The fact that the literature on the adoption of e-learning pervasive and that it explains this field with a broad perspective with the bibliometric analysis method makes this study necessary and important. In this context, the current study searches for answer to the following research questions:

RQ1. What is the status of co-authorship?

RQ2. What is the distribution and trend of keywords?

RQ3. What is the position of the authors in citing similar publications?

RQ4. Who are the most influential writers?

RQ5. What are the most influential publications?

RQ6. What are the most influential journals?

RQ7. What are the most influential countries and universities?

Method

This study aims to create a network map of the research literature on e-learning adoption. As e-learning is an interdisciplinary field covering a wide range of topics, an iterative strategy was followed to determine this study's search string. In other words, research related to e-learning literature were examined in order to determine the synonyms of electronic learning in the literature (Gurcan et. al., 2021; Mashroofa et. al., 2019). Then, the opinions of the field experts on the extracted terms were taken. The final keywords were determined as a result of the examination made by five field experts and the evaluations of the researchers. As a result of these processes, the search sequence and the search query that meets the other criteria are created as follows:

((“mobile learning” OR “m-learning” OR “distance education” OR “distance learning” OR “online education” OR “online learning” OR “digital learning” OR “digital education” OR “electronic learning” OR “e-learning” OR “blended learning” OR “b-learning” OR “flipped learning” OR “situated learning” OR “ubiquitous learning” OR “computer-based learning” OR “technology-enhanced

learning" OR "internet-based learning" OR "web-based learning") AND ("technology adoption" OR "technology adaptation" OR "behavioral intent" OR "behavioral intention" OR "technology acceptance"))

For bibliometric mapping, the SCI, SSCI, SCI-Expanded and A&HCI indexes in the Web of Science database were selected as the literature source. These indexes were chosen as they are the prominent domain-specific indexes in the indexing of core and high-grade journals that have reached a certain academic maturity (Negahban, 2021). Within the scope of the study, a query was made in the WoS database with terms corresponding to e-learning as of June 2021, without the limitation of publication type and index between the years 2010-2021. A total of 1251 metadata sets were received from the WoS database query, which included information on publication title, publication year, journal, author, keyword, and citation.

Bibliometric analysis can be defined as representing the relationships between disciplines, fields, individual publications, or researchers spatially (Gürcan & Özyurt 2020). It summarizes publication information, along with quantitative statistics regarding the growth of research by years and citations, the ranking of the most productive researchers, the rankings for the countries of the authors, the rankings of the most productive institutions, the rankings of the most influential journals, the distribution and percentage of these variables (Mongeon & Paul-Hus, 2016). In the study, the most influential authors, journals, and institutions have been determined by considering the Total Link Strength – (TLS) attribute. TLS shows the number of links an item has with other items and the total strength of an item's links with other items (Small, 1999).

Keyword co-occurrence, bibliographic coupling, co-authorship and citation analyzes were analyzed through VOSviewer, a tool suitable for this purpose, in line with the research questions by using the meta-data set obtained in this study. In addition, the h index was calculated using Harzing's Publish and Perish program (Keshava et. al., 2008) to identify important researchers and studies cited at high rates in the field. In van Eck & (Waltman, 2017) found that VOSviewer and Cite Space software are frequently used in the comparison of various visualization tools for scientific mapping. VOSviewer is a more user-friendly program that provides essential capabilities for visualizing bibliometric networks (Harzing, 2007). Many studies have used the software in question successfully (Cobo et. al., 2015; van Eck & Waltman, 2010).

Results

Descriptive Analysis

In this section, in the context of research questions, the findings obtained from the study are given under sub-headings. The distribution of studies on the adoption of e-learning by publication type and publication language is presented in Table 1. According to Table 1, most of the studies on the adoption of e-learning in the WoS database consist of articles (f=865, 69.14%) and proceedings papers (f=351, 28.05%). In addition, it was determined that studies covered 10 different languages, and the majority of them (f=1222, 97.68%) are in English.

Table 1

Distribution of Studies According to Publication Type and Language

Document Types		f	%
1	Article	865	69.14
2	Proceedings Paper	351	28.05
3	Early Access	55	4.39
4	Review	31	2.47
5	Book Chapter	18	1.43
6	Data Paper	3	0.23
7	Editorial Material	2	0.15
8	Book	1	0.07
9	Meeting Abstract	1	0.07
Document Languages			
1	English	1222	97.68
2	Spanish	16	1.27
3	Portuguese	5	0.39
4	French	2	0.15
5	Others	6	0.47

Publication trends are an important indicator for predicting changes in an area or subject. Between the years 2010-2021, 1251 studies were published in e-learning adoption and the distribution of publications by years is shown in Figure 1. When Figure 1 is examined, it is revealed that there was a small increase in publications related to the adoption of e-learning between 2010 and 2014. Although there has been an upward trend since 2015, interest in the field has risen fast since 2019. The use of data for only the first six months of 2021 explains the drop in publication dispersion in 2021.

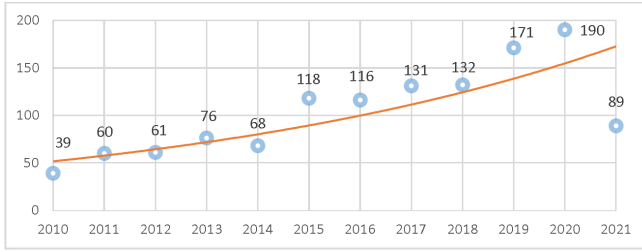

Figure 1

Distribution of Studies on E-Learning Adoption by Years

Bibliometric Analysis

A series of co-authorship analyzes were conducted to examine patterns of scholarly collaboration among authors on e-learning adoption research. Although 29 researchers in the dataset provided collaborative networks between authors with five or more publications, it was determined that there was only co-authorship between 12 researchers, as shown in Figure 2.

Figure 2 shows various scientific cooperation networks among researchers in the field. These networks consist of two to four researchers and include a leading researcher [i.e. the largest node] serving as the connecting node between all other researchers.

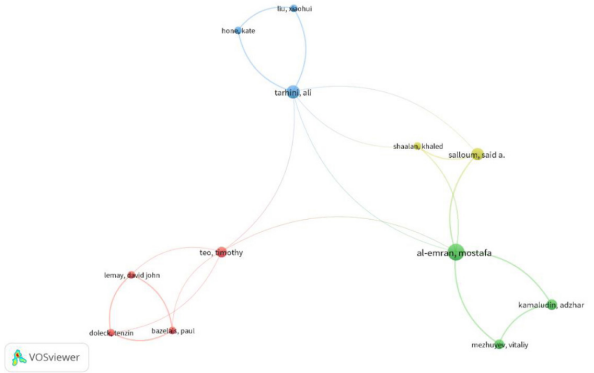

Figure 2

Network Map of Co-authorship in E-Learning Adoption

Co-authorship analysis was performed to identify collaboration among researchers on a country-by-country basis. It has been found that there are 7 different co-authorship clusters on the basis of countries and it is shown in Figure 3. Only countries with 10 or more publications were included in the analysis, and 36 countries were found to be interconnected. In terms of co-authorship, the clusters in which the countries have more collaboration are not very different from each other, and this situation indicates that the clusters there are researchers from countries in different clusters conducting studies together in the field.

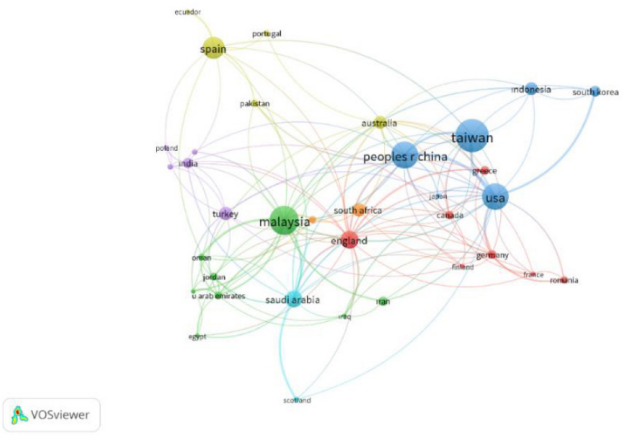

Figure 3

Co-authorship on the Basis of Countries in the Field of E-Learning Adoption

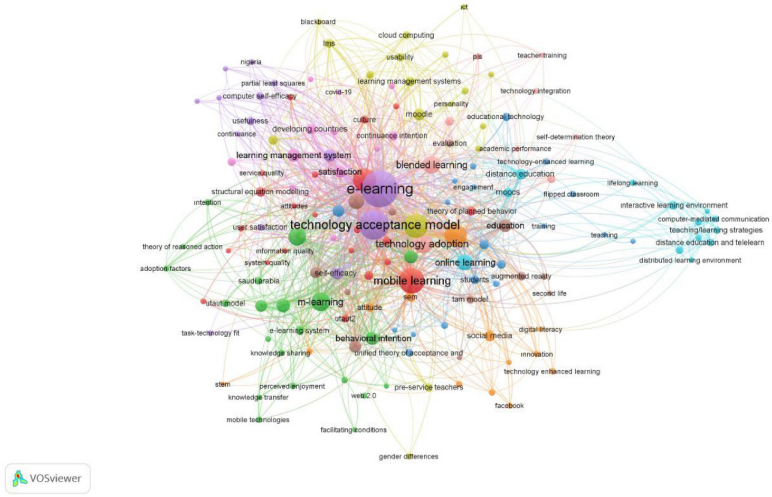

Figure 4

Network Visualization Map of Keywords Co-occurrence

In the topic of e-learning adoption, there are a total of 2566 different keywords in 1251 publications. According to the co-occurrence analysis done using 153 keywords that match the usage criterion in at least 5 publications, the keywords are aggregated in 10 separate clusters (see Figure 4). The clusters' keywords provide information on similar issues researched in the field.

Figure 5 depicts the overlay visualization map that resulted from the term co-occurrence analysis, which depicts the trend across time and provides insight into trend study topics.

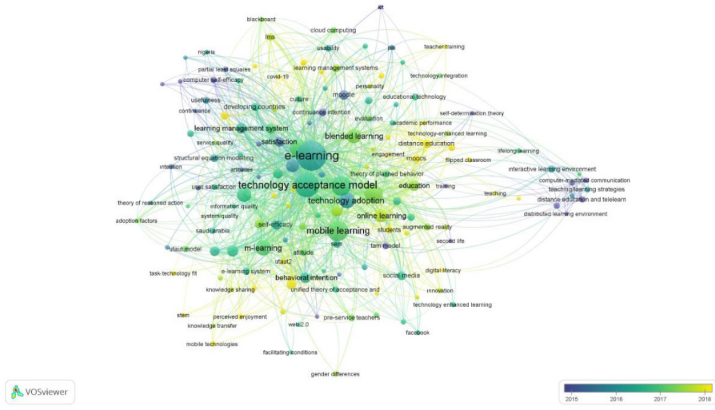

Figure 5

Overlay Visualization Map of Keywords by Year

In addition, a list of the most repeated keywords is given in Table 2. Generally, word repetitions take attention in the studies. This is because it is difficult to use keywords in a single format. For example, authors sometimes use abbreviations and long format of the keyword (such as TAM or Technology Acceptance Model).

Table 2
The most repeated keywords

Keyword	Occurrences	TLS
E-Learning	368	344
Technology Acceptance Model	316	204
Mobile Learning	213	168
Technology Acceptance	154	160
TAM	106	158
Higher Education	106	159
Technology Adoption	63	97
M-Learning	63	98
Blended Learning	52	62
UTAUT	35	115
Online Learning	32	50
Technology Acceptance Model [TAM]	32	43
Perceived Usefulness	32	65
Behavioral Intention	32	47
Education	29	49
Learning Management System	27	49
Structural Equation Modeling	27	50
Covid-19	26	42
Perceived Ease of Use	19	56
Self-Efficacy	15	38

Bibliographic coupling is defined as citing the same publication from two different sources (Singh et. al., 2020). Figure 6 shows the map of the top 100 authors with the highest TLS value, which includes all authors with at least two publications.

According to citation analysis, the top 20 authors with the greatest TLS value are presented in Table 3 (authors with at least 5 publications were included). As a result, noteworthy authors include M. Al-Emran, A. Tarhini, Y. H. Lee, K. Hone, X. Liu, and Y. M. Cheng.

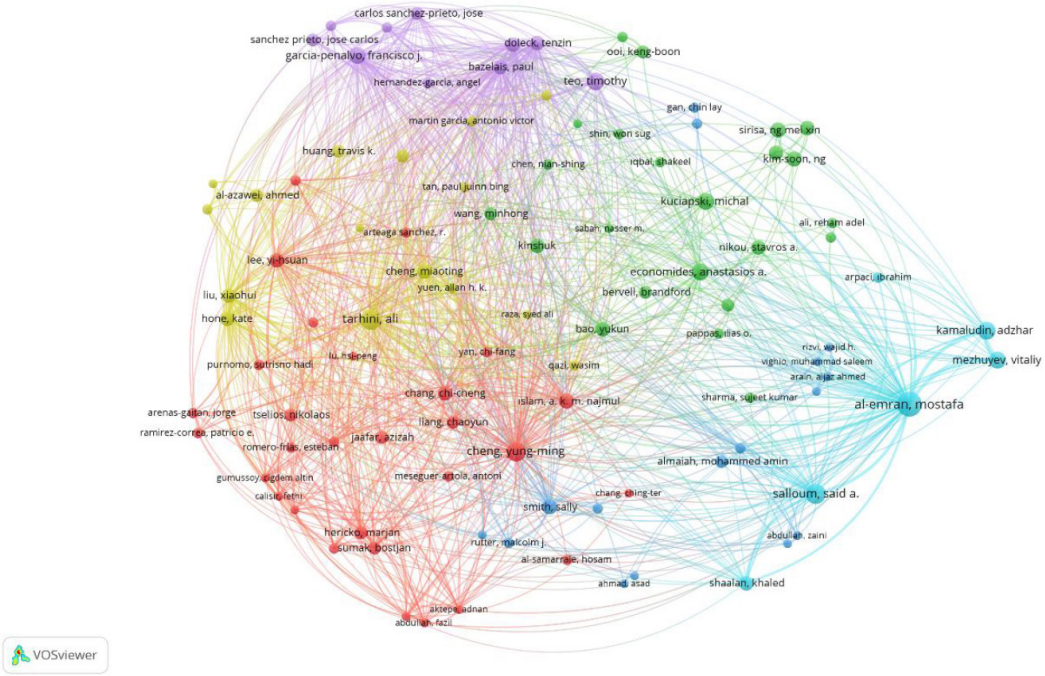

Figure 6

Authors' Bibliographic Coupling Visualization Map

Table 3

The Most Influential Authors in the Adoption of E-Learning

No	Author	University	Publication	Publication Year*	Citation	Citation/ Year*	h-index*	TLS
1	M. Al-Emran	British University in Dubai	15	2018-2021	203	67.67	7	148
2	A. Tarhini	Sultan Qaboos University	11	2013-2019	576	72.00	10	127
3	S. A. Salloum	University of Sharjah	10	2019-2021	73	36.50	4	84
4	V. Mezhuyev	FH Joanneum University of Applied Sciences	7	2018-2021	126	42.00	4	83
5	K. Hone	Brunel University	5	2013-2017	373	46.63	5	81

Contd...

6	X. Liu	Brunel University	5	2013-2017	373	46.63	5	81
7	A. Kamaludin	University Malaysia Pahang	8	2018-2021	133	44.33	5	77
8	T. Timothy	University of Macau	8	2010-2020	128	11.64	7	71
9	K. Shaalan	British University in Dubai	5	2019-2020	61	30.50	3	48
10	P. Bazelais	McGill University	5	2017-2019	32	8.00	3	35
11	T. Doleck	Simon Fraser University	5	2017-2019	32	8.00	3	35
12	D. J. Lemay	McGill University	5	2017-2019	32	8.00	3	35
13	Y. H. Lee	National Central University	5	2011-2014	407	40.70	5	32
14	S. Smith	Edinburgh Napier University	6	2017-2020	26	6.50	2	26
15	A.A. Economides	University of Macedonia	7	2013-2021	245	30.63	5	25
16	Y. M. Cheng	National Taiwan University	9	2011-2021	332	33.20	6	24
17	M. Cheng	Shenzhen University	5	2018-2020	38	12.67	3	23
18	S. A. Nikou	University of Strathclyde	5	2015-2020	206	34.33	4	21
19	F. J. Garcia-Penalvo	Universidad de Salamanca	7	2015-2019	164	27.33	4	16
20	A.K.M.N Islam	Tampere University	6	2011-2015	139	13.90	2	10

* Calculated through the search made with the article title and keywords determined in the study by using Harzing's Publish and Perish software (Keshava et. al., 2008).

The most influential 1251 publications in the field of e-learning adoption were determined according to the citation analysis. Table 4 shows the 10 most influential publications. The publications aimed to reveal the factors affecting the adoption of e-learning. Also, some articles emphasize the importance of external factors by expanding or combining prominent technology adoption models.

Table 4

The Most Influential Publications in E-Learning Adoption

Rank	Year	First Author	Journal	Title of the Article	WoS Cites	GS Cites	Cites/ Year*
1	2010	M. C. Lee	J1	Explaining and predicting users' continuance intention toward e-learning: An extension of the expectation-confirmation model	503	1126	45.73
2	2012	J. Cheon	J1	An investigation of mobile learning readiness in higher education based on the theory of planned behavior	366	1045	40.67
3	2013	R. Cheung	J1	Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning	311	763	38.88
4	2012	S. Y. Park	J2	University students' behavioral intention to use mobile learning: Evaluating the technology acceptance model	276	754	30.67
5	2012	W. Bhuasiri	J1	Critical success factors for e-learning in developing countries: A comparative analysis between ICT experts and faculty	246	798	27.33
6	2010	Y. Liu	J1	Factors driving the adoption of m-learning: An empirical study	232	535	21.09
7	2011	B. Šumak	J3	A meta-analysis of e-learning technology acceptance: The role of user types and e-learning technology types	219	500	21.90
8	2010	R. A. Sanchez	J3	Motivational factors that influence the acceptance of Moodle using TAM	208	604	18.91
9	2015	H. Mohammadi	J3	Investigating users' perspectives on e-learning: An integration of TAM and IS success model	202	484	33.67
10	2016	F. Abdullah	J3	Developing a General Extended Technology Acceptance Model for E-Learning [GETAMEL] by analysing commonly used external factors	197	481	39.40

J1: Computers & Education, J2: British Journal of Educational Technology, J3: Computers in Human Behavior
*Calculated through the search made with the article title and keywords determined in the study by using Harzing's Publish and Perish software (Keshava et. al., 2008).

According to the citation analysis to identify the prominent journals in research on the adoption of e-learning, it was determined that 43 of the journals published at least 5 studies related to the field. Table 5 shows the top 20 journals with the highest TLS value, as determined by the citation analysis. Computers & Education, the most published and cited journal, has the highest TLS value, as seen in Table 5. In addition to Computers & Education, significant journals include Computers in Human Behavior, British Journal of Educational Technology, Education and Information Technologies and The International Review of Research in Open and Distributed Learning (IRRODL). These findings indicate that a significant portion of the existing research on e-learning adoption has been published in specialized journals. These journals have increased their impression in recent years, and important studies have been published e-learning adoption.

Table 5

20 most Influential Journals in the Field of E- Learning Adoption

Rank	Journal	Publication	Citation	h-index*	TLS
1	Computers & Education	57	4694	35	572
2	Computers in Human Behavior	48	3279	33	432
3	Education and Information Technologies	55	351	11	334
4	British Journal of Educational Technology	21	657	12	171
5	Behaviour & Information Technology	18	486	11	150
6	IEEE Access	20	220	8	149
7	The International Review of Research in Open and Distributed Learning	24	504	13	141
8	Interactive Learning Environments	23	269	8	135
9	Educational Technology Research and Development	17	400	11	129
10	Australasian Journal of Educational Technology	14	283	10	91
11	Sustainability	16	76	5	81
12	Turkish Online Journal of Distance Education	8	41	3	75
13	Journal of Educational Computing Research	15	257	9	66
14	Journal of Computing in Higher Education	8	253	6	65
15	Journal of Computers in Education	8	77	3	57
16	Telematics and Informatics	8	171	7	54
17	Internet Research	5	146	4	49
18	Journal of Information Technology Education: Research	13	52	5	48
19	International Journal of Information and Learning Technology	8	87	5	48
20	Educational Technology & Society	15	523	11	45

* Calculated through the search made with the article title and keywords determined in the study by using Harzing's Publish and Perish software (Keshava et. al., 2008).

As a result of the citation analysis, the most influential countries and institutions in adopting e-learning have been determined. It has been observed that research on the adoption of e-learning has been carried out in 94 different countries and 1215 institutions. The number of citations, the number of publications, the TLS value and the h-index, are used to determine the most influential universities and countries. The top 20 universities in the field of e-learning adoption are given in Table 6. According to Table 6, TLS values, h-index, and citation numbers from National Central University, University Malaysia Pahang and Brunel University are remarkable.

Table 6

20 Most Influential Universities in the Field of E- Learning Adoption

No	Country	University	Publication	Citations	h-index	TLS
1	Taiwan	National Central University	13	966	8	83
2	Malaysia	Universiti Malaysia Pahang	14	222	7	66
3	England	Brunel University	6	491	6	60
4	Oman	Sultan Qaboos University	9	282	8	52
5	United Arab Emirates	British University in Dubai	9	62	3	41
6	Malaysia	Universiti Sains Malaysia	21	159	8	41
7	Malaysia	Universiti Malaya	13	170	6	40
8	Saudi Arabia	King Abdulaziz University	11	154	5	36
9	Saudi Arabia	King Faisal University	11	155	4	32
10	Malaysia	Universiti Tunku Abdul Rahman	12	241	3	32
11	Taiwan	Chaoyang University of Technology	9	332	6	30
12	Finland	University of Turku	8	152	4	30
13	Hong Kong	University of Hong Kong	17	229	7	29
14	Malaysia	Universiti Teknologi Malaysia	15	150	6	25
15	Spain	University of Salamanca	18	327	6	24
16	United Arap Emirates	University of Sharjah	5	12	2	23
17	Taiwan	National Taiwan Normal University	13	180	6	22
18	USA	Texas Tech University	6	428	3	21
19	Slovenia	University of Maribor	5	306	3	19
20	Spain	University of Seville	11	247	7	18

* Calculated through the search made with the article title and keywords determined in the study by using Harzing's Publish and Perish software (Keshava et. al., 2008).

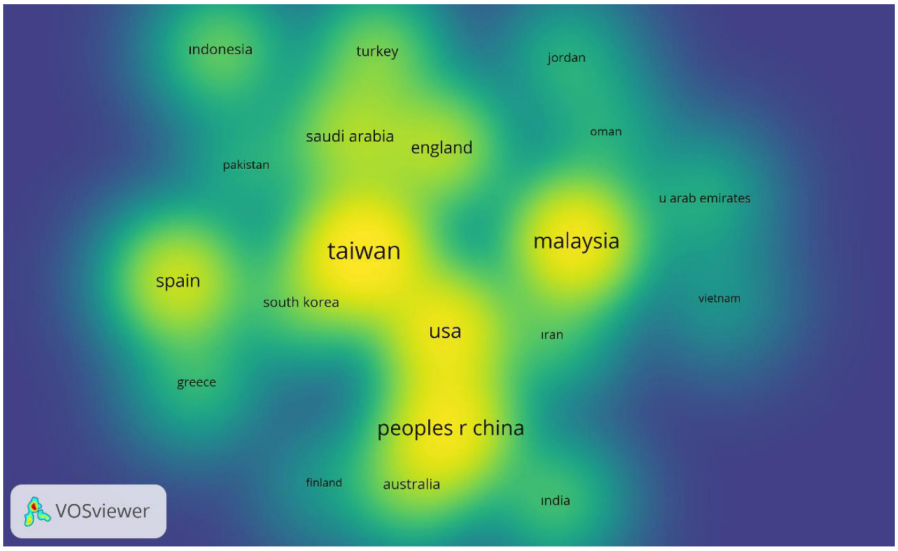

Figure 7

Density Map of Top 20 Countries

When Figure 7 is examined, Taiwan, Malaysia, China, the USA and Spain are among the top 20 countries in the adoption of e-learning. These results conform to Table 6, but in some countries (eg Finland, Slovenia, Oman, and Hong Kong), only certain universities come to the fore.

Discussion, Conclusion, and Recommendations

This study aims to find co-authorship relationships, trending topics, influential authors, journals and publications by using a metadata set of published research e-learning adoption. This study used the data of 1251 studies obtained from the WoS database.

When the distribution of studies on the adoption of e-learning is examined according to the type of publication and language of publication, it has been determined that the majority of the studies were published as articles (n=865). On the other hand, it is not surprising that the English language (n=1222) comes to the fore in most studies. In addition, in terms of the trends in the obtained publications, it has been observed that there has been a general increase in publications since 2010. A significant increase has also been observed in research on the adoption of e-learning since 2019. The reason for this situation may be the impact of the Covid-19 pandemic in every field as of 2019. Many studies have been conducted on the adoption of e-learning in recent years (Özköse & Gencer, 2017; Tekdal, 2021). Therefore, the slope line shows that the increase in the number of publications will continue.

According to the co-authorship analysis, the cooperation between the clusters of researchers conducting a study on the adoption of e-learning needed to be stronger.

Furthermore, the number of active researchers was found to be low in the majority of clusters. M. Al-Emran, A. Tarhini, S. A. Salloum, and T. Teo have become prominent in the co-authorship clusters. According co-authorship map, new study groups focusing on e-learning adoption have emerged in recent years. New researchers have appeared in co-authorship clusters that form the center of the field. It is thought that the situation arises from the fact that there is a potential audience using new technologies. Co-authorship analysis by country revealed that research on e-learning adoption reflects cross-country collaboration. Taiwan, Malaysia, China, the USA and Spain have been prominent countries adopting e-learning. It is also found out that the co-authorship relationship between Taiwan, the USA and China is strong.

E-learning, mobile learning, blended learning, mobile technologies, higher education, TAM, UTAUT, TPB, TRA, SEM, MOODLE, MOOC, blackboard, cloud computing, augmented reality, perceived usefulness, perceived ease of use, behavioral intention and covid-19 were the most prominent keywords according to the co-occurrence analysis. This situation provides important findings regarding identifying research topics that form the basis of the adopting e-learning and trend research topics. It is seen that the most used keyword in the field of e-learning adoption is “e-learning”. It is noteworthy that the words “mobile learning”, “blended learning”, and “online learning” stand out as the most used keywords regarding learning. The prominence of the keyword “higher education” refers to the importance of e-learning in higher education. Since perceived usefulness and perceived ease of use are determinants of people’s intentions towards TAM, it is not surprising that the keywords “perceived usefulness”, “perceived ease of use”, and “behavioral intention” are among the most used keywords. It has been also observed that the researchers focused on self-efficacy, perceived enjoyment and social impact factors. It is not surprising that the term “technology acceptance model” has the second-highest TLS value among the keywords. It has been the most widely used theory to measure the success of new technology in terms of technology acceptance and use (Surendran, 2013).

The fact that the “UTAUT” model proposed by Venkatesh et. al., (2003) is among the most important keywords may be due to its preference in recent studies (Salloum et. al., 2019; Tan, 2013; Singh et. al., 2021). It is also indicated in Figure 5 that researchers recently turned to the UTAUT-2 model proposed by (Venkatesh et. al., 2012).. Structural Equation Modeling has come to the fore in analyzes made in the adoption of e-learning. This model is used in the disciplines such as marketing, psychology etc., to evaluate the relationships between factors and to test models or theories. Researchers have recently focused on the partial least squares structural equation modelling (PLS-SEM) method. Candidates who will do research in this field are recommended to examine studies using these methods (Chatti & Hadoussa, 2021; Li et. al., 2021; Yunusa & Umar, 2021). It is noteworthy that the term “Covid-19”, which is another important term, is among the most used keywords. It can be said that as the education sector has been affected by the Covid-19 pandemic, which has been effective since 2019, distance education is applied, and this situation has caused the examination of the effects of the Covid-19 crisis on education (Abbad, 2021; Cicha et. al., 2021; San-Martín et. al., 2020).

As a result of the bibliographic coupling study, it was discovered that certain researchers specialize in various areas and are located outside the field's core. In addition, it has been determined that researchers, especially in the Middle East, are studying similar and new topics compared to other clusters. As a result of this study, although A. Tarhini seems to be the most influential author in the field of e-learning adoption in terms of the number of citations, he has not contributed to the field after 2019. M. Al-Emran, on the other hand, is the author with the highest total link strength. This author has pioneered the field in recent years with his studies on the adoption of e-learning. On the other hand, Y. H. Lee, K. Hone, X. Liu, and Y. M. Cheng were found to be influential researchers in the field. In addition, researchers S. A. Salloum, V. Mezhuyev and A. Kamaludin, who contributed to the field after 2018, come to the fore. It is noteworthy that the researchers e-learning adoption are predominantly those at universities in Taiwan, Oman, and the United Arab Emirates. In Mailizar et. al., (2021) stated in his research that although the Taiwanese government encourages universities to develop e-learning systems, most instructors resist using e-learning regardless of its proposed benefits. In addition, Raza et. al., (2021) stated in their study that there is a relatively slow rate of technology adoption in general-purpose technologies in Middle Eastern countries. The resistance against the adoption of e-learning in these developing countries encourages researchers to study on the adoption of e-learning.

Citation analysis was utilized to determine the most effective articles, and the concepts of "e-learning" and "m-learning" were applied in the most effective distance education studies. In these studies, TAM (Yu, 2021), TPB (Icek, 1991), Expectation Confirmation Theory (Arezki et. al., 2021; Davis, 1989) and ISSM (DeLone & McLean, 1992) were used to determine the factors affecting e-learning and m-learning adoption. In (Šumak et. al., 2011), stated in their study in 2011 that TAM was preferred by 86% in the theories applied on the adoption of e-learning. The examination of the most influential articles shows that in the field of e-learning adoption, the theories/models were preferred to be applied by integrating and expanding them with external factors. The results of our study stood out among the 10 most influential articles of meta-analysis research. Therefore, it reveals the importance of review and meta-analysis studies. New researchers need to use the articles in Table 4 to establish the theoretical framework, especially for the adoption of e-learning in their thesis or other studies.

According to the analyses made about the journals, Computers & Education has been the most published and cited journal in e-learning adoption. Education and Information Technologies, IRRODL, and Computers in Human Behavior have also been influential. The fact that the journals Computers & Education and Computers in Human Behavior, which were in the first two ranks in our study, were in the first two ranks in the study of (Šumak et. al., 2011) in which they analyze the research regarding the adoption of e-learning, is parallel with the findings of our study. Accordingly, it is thought that it is important to use Computers & Education, Education and Information Technologies and Computers in Human Behavior journals in the study of researchers on the adoption of e-learning. Specialized journals play a fundamental role in the development of a research field, as they provide avenues for the dissemination of specialist knowledge,

facilitate communication and exchange of ideas among researchers, and contribute to the formation of communities of scientific experts in the field (Bhattacherjee, 2001b).

It has been determined that the most influential countries are Taiwan, Malaysia, China, the USA and Spain. In addition, National Central University, University Malaysia Pahang, Brunel University have been prominent universities. On the other hand, in some prominent countries (for example, Finland, Slovenia, Oman, and Hong Kong), only certain universities come to the fore. In addition, although Turkey, Australia and Indonesia are prominent countries, it is remarkable that there are no universities in the top 20 of these countries. Although this indicates that research in some countries focuses on e-learning adoption, this research concentration is not concentrated at a particular university or promotes a particular university in these countries to the top 20 rankings. It is noteworthy that the two prominent universities are in Taiwan and Malaysia, which contribute the most to the field. In Bhattacherjee, (2001a), stated in their research that the Taiwanese government has established an excellent Information and Communication Technologies infrastructure, and has encouraged universities to develop e-learning systems, but only some of the instructors resist the use of e-learning regardless of its proposed benefits. In Vanderstraeten et. al., (2016), showed in their study that many higher education institutions in Malaysia had implemented e-learning, but the adoption rate among students is still low in Malaysia. Therefore, this situation encourages researchers in Taiwan and Malaysia to investigate the adoption of e-learning by instructors and students.

Compared to the study conducted by Gürcan & Özyurt, (2020), similar and different findings were found. When analyzed on the basis of countries, the USA and Taiwan were prominent. In addition, Malaysia and China came to the fore in our study. National Central University came to the fore in both studies when analysed on the basis of institutions. When examined on the basis of authors, Ali Tarhini stood out in the other study, while Mostafa Al-Emran drew attention to our study. In addition, in the co-authorship analysis conducted in our study, it was determined that these authors had collaborative works. Finally, when analyzed on the basis of magazines, Computers & Education came to the fore.

In conclusion, although the findings in this article do not cover all the information, this article has important and enlightening values for researchers interested in adopting e-learning. The study aims to bring out a bibliometric map of the field of adoption of e-learning and to present a study that researchers can refer to in their new research in this field. This study includes studies on e-learning adoption only in the WoS database between the years 2010 and 2021. In the future, researchers can focus on the studies on e-learning adoption for all years using important databases such as SCOPUS, PubMed etc. They can also reveal the trend in e-learning adoption of leading models such as TAM, UTAUT and UTAUT-2, which are important for technology adoption and use.

References

[1] Gurcan, F., Ozyurt, O., & Cagitay, N. E., Investigation of emerging trends in the e-learning field using latent dirichlet allocation. *International Review of Research in Open and Distributed Learning*, 22(2), 1-18 (2021).

[2] Al-Fraihat, D., Joy, M., & Sinclair, J., Evaluating E-learning systems success: An empirical study. *Computers in Human Behavior,* 102, 67-86 (2020).

[3] Kuliya, M., & Usman, S. Perceptions of E-learning among undergraduates and academic staff of higher educational institutions in north-eastern Nigeria. *Education and Information Technologies,* 26, 1787-1811 (2021).

[4] Al-Rahmi, W. M., Alias, N., Othman, M. S., Alzahrani, A. I., Alfarraj, O., Saged, A. A., & Rahman, N. S. A. Use of e-learning by university students in Malaysian higher educational institutions: A case in Universiti Teknologi Malaysia. *Ieee Access,* 6, 14268-14276 (2018).

[5] Wolfe, C. R., & Cedillos, E. M., E-Communications Platforms and E-Learning. In International Encyclopedia of the Social & Behavioral Sciences: Second Edition (2015), doi: 10.1016/B978-0-08-097086-8.41022-6.

[6] Cheon, J., Lee, S., Crooks, S. M., & Song, J., An investigation of mobile learning readiness in higher education based on the theory of planned behavior. *Computers & education, 59*(3), 1054-1064 (2012).

[7] Li, C., He, L., & Wong, I. A., Determinants predicting undergraduates' intention to adopt e-learning for studying english in chinese higher education context: A structural equation modelling approach. *Education and Information Technologies,* 26, 4221-4239 (2021).

[8] Šumak, B., Heričko, M., & Pušnik, M., A meta-analysis of e-learning technology acceptance: The role of user types and e-learning technology types. Computers in Human Behavior (2011), doi: 10.1016/j.chb.2011.08.005.

[9] Surendran, P., Technology acceptance model: A survey of literature. *International journal of business and social research,* 2(4), 175-178 (2012).

[10] Legris, P., Ingham, J., & Collerette, P., Review of the technology acceptance model. *Information and management,* 40(3), 191-204 (2003).

[11] Ajzen, I., Understanding attitudes and predictiing social behavior. Englewood cliffs (1980).

[12] Icek, A., The theory of planned behavior. Organizational behavior and human decision processes, 179-211 (1991).

[13] DeLone, W. H., & McLean, E. R., Information systems success: The quest for the dependent variable. *Information Systems Research* (1992), doi: 10.1287/isre.3.1.60.

[14] Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D., User acceptance of information technology: Toward a unified view. *MIS Quarterly,* 2003, 425-478 (2003).

[15] Venkatesh, V., Thong, J. Y., & Xu, X., Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly,* 157-178 (2012).

[16] Abbad, M. M., Morris, D., & de Nahlik, C., Looking under the Bonnet: Factors affecting student adoption of E-learning systems in Jordan. *International Review of Research in Open and Distributed Learning,* 10(2) (2009), doi: 10.19173/irrodl.v10i2.596.

[17] Abdullah, F., & Ward, R., Developing a General Extended Technology Acceptance Model for E-Learning (GETAMEL) by analysing commonly used external factors. *Computers in human behavior,* 56, 238-256 (2016).

[18] Rahmi, B., Birgoren, B., & Aktepe, A., Identifying factors affecting intention to use in distance learning systems. *Turkish Online Journal of Distance Education,* 22(2), 58-80 (2021).

[19] Mohammadi, H., Investigating users' perspectives on e-learning: An integration of TAM and IS success model. *Computers in human behavior,* 45, 359-374 (2015).

[20] Okazaki, S., & Renda dos Santos, L. M., Understanding e-learning adoption in Brazil: Major determinants and gender effects. *International Review of Research in Open and Distributed Learning,* 13(4), 91-106 (2012).

[21] Rizun, M., & Strzelecki, A., Students' acceptance of the COVID-19 impact on shifting higher education to distance learning in Poland. *International journal of environmental research and public health,* 17(18), 6468 (2020).

[22] Salloum, S. A., Al-Emran, M., Shaalan, K., & Tarhini, A., Factors affecting the E-learning acceptance: A case study from UAE. *Education and Information Technologies, 24,* 509-530 (2019).

[23] Tan, P. J. B., Applying the UTAUT to understand factors affecting the use of English e-learning websites in Taiwan. *SAGE* Open, 3(4) (2013), doi: 10.1177/2158244013503837.

[24] Tarhini, A., Hone, K., & Liu, X., Measuring the moderating effect of gender and age on e-learning acceptance in England: A structural equation modeling approach for an extended technology acceptance model. *Journal of Educational Computing Research,* 51(2), 163-184 (2014).

[25] Hung, J. L., Trends of e-learning research from 2000 to 2008: Use of text mining and bibliometrics. *British Journal of Educational Technology,* 43(1), 5-16 (2012).

[26] Taylor, E. W., Adult Education Quarterly from 1989 to 1999: A content analysis of all submissions. *Adult Education Quarterly,* 51(4), 322-340 (2001).

[27] Mashroofa, M. M., Jusoh, M., & Chinna, K., Research trend on the application of "E-Learning Adoption Theory": A scientometric study during 2000-2019, based on Web of Science and SCOPUS. *COLLNET Journal of Scientometrics and Information Management,* 13(2), 387-408 (2019).

[28] Negahban, M. B., Network analysis and scientific mapping of the field of e-learning in Iran. *COLLNET Journal of Scientometrics and Information Management,* 15(1), 1-8 (2021).

[29] Gurcan, F., & Ozyurt, O., Emerging trends and knowledge domains in E-learning researches: Topic modeling analysis with the articles published between 2008-2018. *Journal of Computer and Education Research,* 8(16), 738-756 (2020).

[30] Mongeon, P., & Paul-Hus, A., Liputan jurnal Web of Science dan Scopus: analisis komparatif. *Scientometrics,* 106(1), 213-228 (2016).

[31] Small, H., Visualizing science by citation mapping. *Journal of the American society for Information Science,* 50(9), 799-813 (1999).

[32] Ganjihal, G., & Gowda, M. P., ACM transaction on information systems (1989-2006): A bibliometric study. *Information Studies,* 14(4), 223-234 (2008).

[33] van Eck, N. J., & Waltman, L., Citation-based clustering of publications using CitNetExplorer and VOSviewer. *Scientometrics,* 111(2), 1053-1070 (2017).

[34] Harzing, A., Publish or Perish. https://harzing.com/resources/publish-or-perish (2007).

[35] Cobo, M. J., Martínez, M. Á., Gutiérrez-Salcedo, M., Fujita, H., & Herrera-Viedma, E. 25 years at knowledge-based systems: a bibliometric analysis. *Knowledge-based systems, 80,* 3-13 (2015).

[36] van Eck, N. J., & Waltman, L., Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics,* 84(2), 523-538 (2010).

[37] Özköse, H., & Gencer, C. T., Bibliometric analysis and mapping of management information systems field. *Gazi University Journal of Science,* 30(4), 356-371 (2017).

[38] Tekdal, M., Trends and development in research on computational thinking. *Education and Information Technologies,* 26(5), 6499-6529 (2021).

[39] Singh, M., Adebayo, S. O., Saini, M., & Singh, J., Indian government E-learning initiatives in response to COVID-19 crisis: A case study on online learning in Indian higher education system. *Education and Information Technologies,* 26(6), 7569-7607 (2021).

[40] Yunusa, A. A., & Umar, I. N., A scoping review of critical predictive factors (CPFs) of satisfaction and perceived learning outcomes in E-learning environments. *Education and Information Technologies, 26,* 1223-1270 (2021).

[41] Chatti, H., & Hadoussa, S., Factors affecting the adoption of E-learning technology by students during the COVID-19 quarantine period: The application of the UTAUT model. *Engineering, Technology & Applied Science Research,* 11(2), 6993-7000 (2021).

[42] Abbad, M. M., Using the UTAUT model to understand students' usage of e-learning systems in developing countries. *Education and Information Technologies,* 26(6), 7205-7224 (2021).

[43] San-Martín, S., Jiménez, N., Rodríguez-Torrico, P., & Piñeiro-Ibarra, I., The determinants of teachers' continuance commitment to e-learning in higher education. *Education and Information Technologies,* 25(4), 3205-3225 (2020).

[44] Cicha, K., Rizun, M., Rutecka, P., & Strzelecki, A., COVID-19 and higher education: First-year students' expectations toward distance learning. *Sustainability,* 13(4), 1889 (2021).

[45] Mailizar, M., Burg, D., & Maulina, S., Examining university students' behavioural intention to use e-learning during the COVID-19 pandemic: An extended TAM model. *Education and Information Technologies,* 26(6), 7057-7077 (2021).

[46] Raza, S., Qazi, W., Khan, K., & Salam, J., Aislamiento social y aceptación del sistema de gestión del aprendizaje (LMS) en tiempos de la pandemia COVID-19: Una expansión del modelo UTAUT. *Journal of Educational Computing Research* (2020).

[47] Yu, P., E-learning practice at universities and colleges in Taiwan. Taipei (2021).

[48] Arezki, R., Fan, R. Y., & Nguyen, H., Technology adoption and the middle-income trap: Lessons from the Middle East and East Asia. *Review of Development Economics,* 25(3), 1711-1740 (2021).

[49] Davis, F. D., Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340 (1989).

[50] Bhattacherjee, A., Understanding information systems continuance: An expectationconfirmation model. *MIS quarterly,* 25(3), 351–370 (2001).

[51] Bhattacherjee, A., An empirical analysis of the antecedents of electronic commerce service continuance. *Decision support systems,* 32(2), 201-214 (2001).

[52] Vanderstraeten, R., Vandermoere, F., & Hermans, M., Scholarly communication in AERA journals, 1931 to 2014. *Review of Research in Education,* 40(1), 38-61 (2016).

[53] Wang, S. C., Cowie, B., & Jones, A., Challenges of e-learning for university instructors in Taiwan. In The 16th International Conference on Computers in Education (ICCE 2008). Taipei, Taiwan, pp. 229-236, (2008, October).

[54] Haron, H., & Sahar, S., An Investigation on predictors of e-learning adoption among Malaysian e-learners. In 2010 International Conference on Science and Social Research (CSSR 2010), pp. 927-932. IEEE (2010, December).