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Review

Usability of University Websites as Information Sources: A Review and Synthesis Based on 2021 Publications Indexed in Scopus Database

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Abstract: Universities' identities and institutional images are showcased on their websites to the rest of the world. Nowadays, many university websites (UW)s have been well-investigated for usability improvement for all users in general. This study aims to review the publications indexed in the Scopus database in 2021 using the search term 'University Websites' and to synthesize the main information being discussed in the manuscripts. Two main reasons why only papers published in 2021 were selected for this study. Firstly, in terms of the number of publications (N = 456) indexed in Scopus from 1996 to 2021, the 2021 publications are the most recent complete year. Secondly, 2021 topped the list of publications along with 2020. For the year 2021, a total of 58 publications were found in the Scopus database as of February 26, 2022. After screening all the papers, only 39 papers were used for this quantitative analysis. The present systematic review presented three major trends. Firstly, the publications on the UWs are expected to be higher in near future aligned with the speed of Industry 4.0 development worldwide. Secondly, there is a total of 24 countries and 1 region (Latin America) found in this review, with Indonesia leading the list with 8 publications. Thirdly, all the papers aimed to identify the obstacles and recommended ways and room for future improvements for all users regarding their UWs. This review paper highlighted the importance of having effective and up-to-date websites from social and economic viewpoints. It can be synthesized here that continual improvements in the knowledge of the effective usability of a UW can sustain a university's reputation and ranking ultimately.

Keywords: websites, usability, public users, academics, university

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1. Introduction

Usability can be defined as a system's ability to provide its users with the tools they need to carry out tasks in a safe, effective, and efficient manner while having fun [1]. The University website (UW) has been a focus of studies in the literature because of the importance of the university's identities and images that can be portrayed to the rest of the world on its websites [2]. Given the Internet's pervasiveness in many aspects of life, the UWs are an effective tool for building an institutional image and engaging with internal and external customers [3]. A UW can serve as a portal for information, products, and services offered by the institution. With millions of websites, it's critical that the material represents the demands of students, faculty, and other academic institutions as major consumers [4].

Higher education institutions are now heavily reliant on the Internet. Higher education institutions can give information and services to their target audiences through their websites in an effective, efficient, and satisfactory manner, regardless of disability [5]. One of the most essential factors for evaluating higher education websites around the world is academic websites [6]. This is especially true in higher education, which is the principal engine of general societal growth. Any institution should have a high-quality, readily navigable UW, as this is frequently the first point of contact and impression for new potential students, as well as the first step in forming a connection with the social economy and society [7]. The UW can be utilized as a publicity campaign and a way to learn more about the organization [8]. For promoting private colleges and universities, website influence is quite important [9]. Most UWs rapidly become a key source of information, allowing users to converse and share pertinent information [10]. Other importance includes it can serve as a virtual portal to vital resources for its constituents. It can be quite useful in communicating information about a university to many people. As a result, the quality of a UW necessitates specific consideration to suit the expectations of all users [11]. Therefore, UW should be user-friendly [12] to meet the expectations of its visitors.

UWs had been well investigated for improvement of usability for all users in general [3, 5, 8, 10-11, 13-24], such as students-lectures [4, 13, 25], people with disabilities [26], and even during the pandemic time [26-29]. However, there has been no holistic understanding and general trends based on the above literature on UW. The current topic was investigated to give a better understanding and effectiveness of UW. This piece of information will benefit both the universities, to improve their UW, and the users, as a guide to selection of the most appropriate UW as their source of information.

Therefore, the aim of this systematic literature review was to review the publications indexed in the Scopus database in 2021 with the keywords 'University website' and to synthesize the information being reviewed for improvements of UW in the future.

2. Methodology

2.1 *Research approach*

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) systematic literature review (SLR) approach of [30] was used in the current review to supplement the established body of information on UWs. PRISMA is an evidence-based standard for reporting that is useful for critical appraisal. Overall, Figure 1 illustrates the measures of the formal approach that was modified for this review. The process is divided into several processes as follows: selecting online database sources as research literature; constructing keywords for performing a search; determining criteria of inclusion and exclusion; extracting data; and examining and analyzing the result to answer the research question.

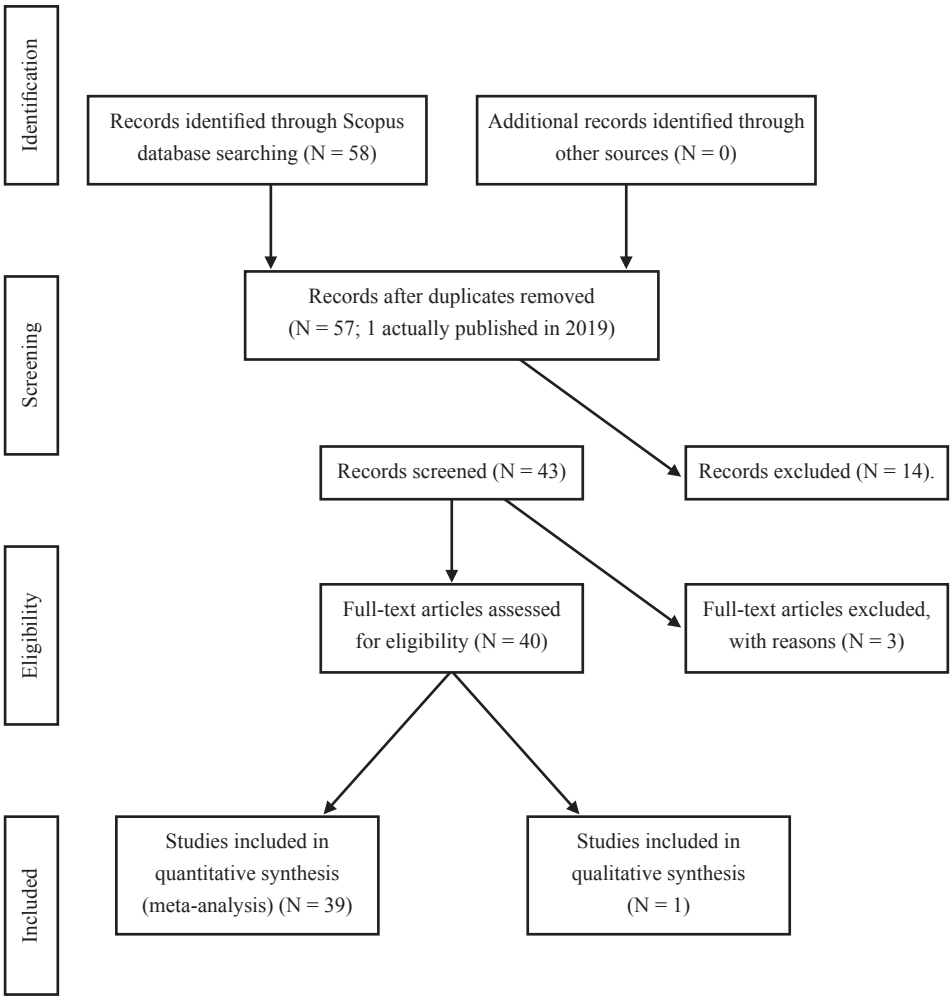

Figure 1. Flowchart of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (adapted from [30]), used in the present study.

2.2 *Article selection procedure*

The first process is selecting online database sources as research literature. It's used to discover a suitable conference, journals or other publication types. The main database, Scopus, was used for the literature review because it is the most widely used database for conducting literature searches. As of April 29, 2020, Scopus is the largest dynamic database for reference information examining writings with logical diaries, books, and collection procedures [31]. In this review, the keyword 'University Websites' was entered to find papers from 2021 available in the Scopus database. From the search, only abstracts with relevant keywords and topics that addressed and studied polluted soils were selected. To avoid bias, the initial selection was based on the paper's title and relevant keywords, regardless of the author's name and country.

2.3 *Data extraction*

Two main reasons why only papers published in 2021 were selected for this study. Firstly, in terms of the number of publications (N = 456) indexed in Scopus from 1996 to 2021, the 2021 publications are the most recent complete year (Figure 2). Secondly, 2021 topped the list of publications along with 2020 (also with 58 publications).

For the year 2021, a total of 58 publications were found in the Scopus database for the search term 'University

Websites' (searched on February 26, 2022). However, of these, 14 articles related to university library websites were discarded. One paper was discarded because it had already been published in 2019). One article about a university's education website, one about a university's sports tourism website, and one identified article were discarded. Thus, 40 papers remained for this review. Of these, 1 paper is a review paper, while the rest were research papers related to qualitative or metal analytic case studies. The 39 papers were included in this quantitative analysis.

This section may be divided into subheadings. It should provide a concise and precise description of the experimental results, their interpretation, and the experimental conclusions that can be drawn.

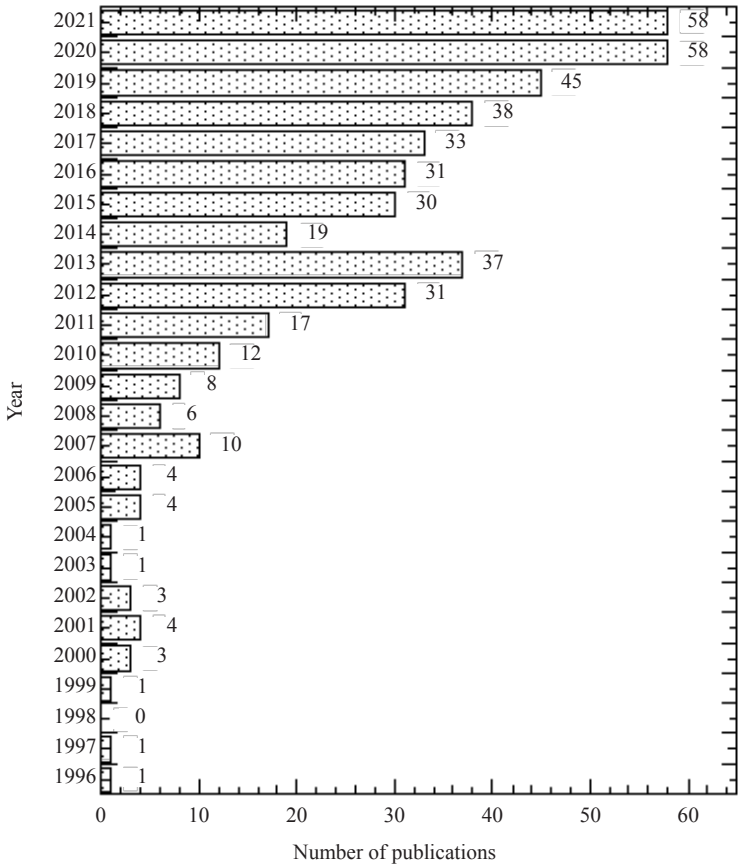

Figure 2. Number of publications (N = 456) indexed in Scopus with the keywords 'University Website' as searched on 26 February 2021.

2.4 *Data analysis*

All graphical bar charts were plotted using the KaleidaGraph (Version 3.08, Synergy Software, Eden Prairie, MN, USA). In the graphs, curve fit selected an exponential regression for modeling the relationship between the increasing years and numbers of publications. This exponential model is logically acceptable and appropriate because it gave the best plot with a constant (λ) (with an R-value) for the relationships that fit the purpose of this study well.

3. Results and discussion

The present systematic review presented three major trends.

3.1 *Firstly, the publications on the UWs are expectedly to be higher in near future aligned with the speed of Industry 4.0 development worldwide*

The Projection of a future number of publications until the year 2050 to be indexed in Scopus with the keywords 'University Website' is given in Figure 3. The best plot was estimated using an exponential model in Figure 3 with a constant (λ) of 0.199 (R = 0.94) to summarize the positive relationship between the increasing years and the number of publications. Furthermore, this model is logically selected based on increasing exponentially as expected. However, the increasing rate could be arguably a rebuttal because there is no scientific data to support this claim. Further validation is always needed with well-designed quantitative studies in the future.

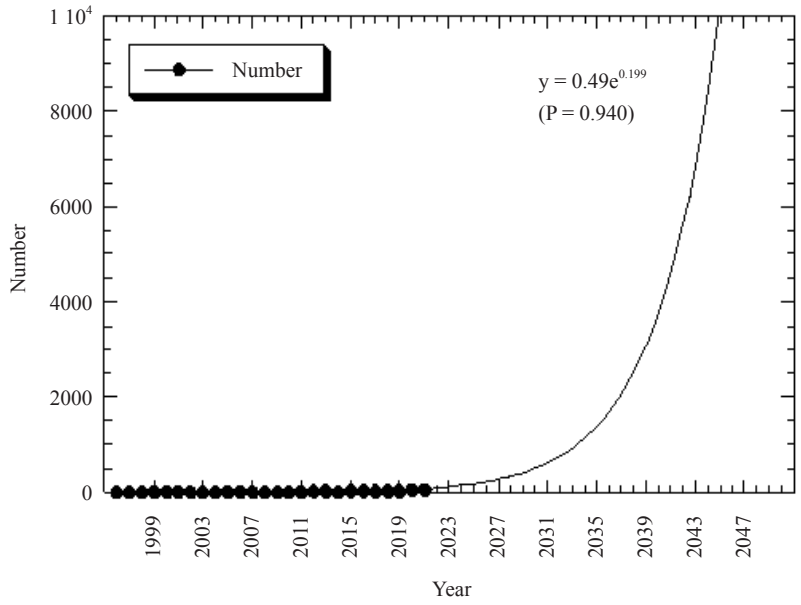

Figure 3. Projection of a future number of publications from 1996 until the year 2050 to be indexed in Scopus with the keywords 'University Website', based on N = 456 papers indexed in Scopus as searched on 26 February 2022. The line was based on the exponential equation.

Using the keyword 'Industry 4.0' searched on the Scopus database on 13 March 2022, there was a total of 6235 papers in the article title, from 2012 to 2021. Within the same period of time, there was a total of 380 papers with the keyword 'University website' searched at the same time. The projection of a future number of publications from 2012 until the year 2050 to be indexed in Scopus with the keywords 'University Website' and Industry 4.0), indexed in Scopus are presented in Figure 4. The reason why papers were only found starting from 2012 was the fact that Industry 4.0 was only begun its idea and originated in 2011 from a project in the high-tech strategy of the German [32].

Again, Figure 4 used an exponential model to estimate the best plot with a high constant (λ) of 0.72 (R = 0.85) to summarize the positive relationship between the increasing years and numbers of publications with the keyword 'Industry 4.0'. This justified the speed of Industry 4.0 worldwide with a high positive constant of 0.72. This trend is well followed by the relationship between the increasing years and numbers of publications with the keyword 'University website', with a positive constant (λ) of 0.084 (R = 0.85), even though it is significantly lower when compared to the previous constant.

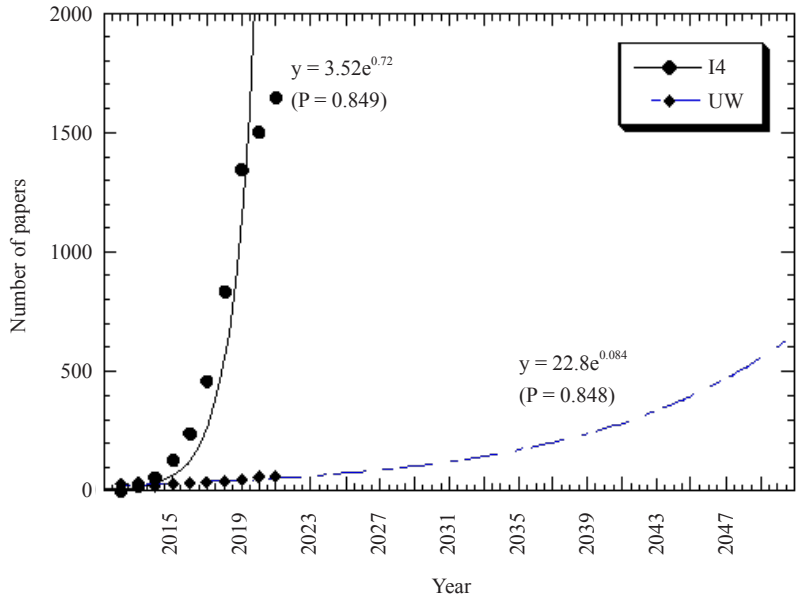

Figure 4. Projection of a future number of publications from 2012 until the year 2050 to be indexed in Scopus with the keywords 'University Website (UW) (380 papers)' and Industry 4.0 (I4) (6235 papers), indexed in Scopus as searched on 13 March 2022. The lines were based on the exponential equation.

The relationships between the keywords 'University Website' and Industry 4.0', indexed in Scopus from 2012 to 2021, are presented in Figure 5. The relationship can be simply indicated by a linear equation, where the positive constant is 0.017 (R = 0.90). This direct significant relationship showed the number of papers on UW is well correlated positively with the increasing numbers of papers on Industry 4.0.

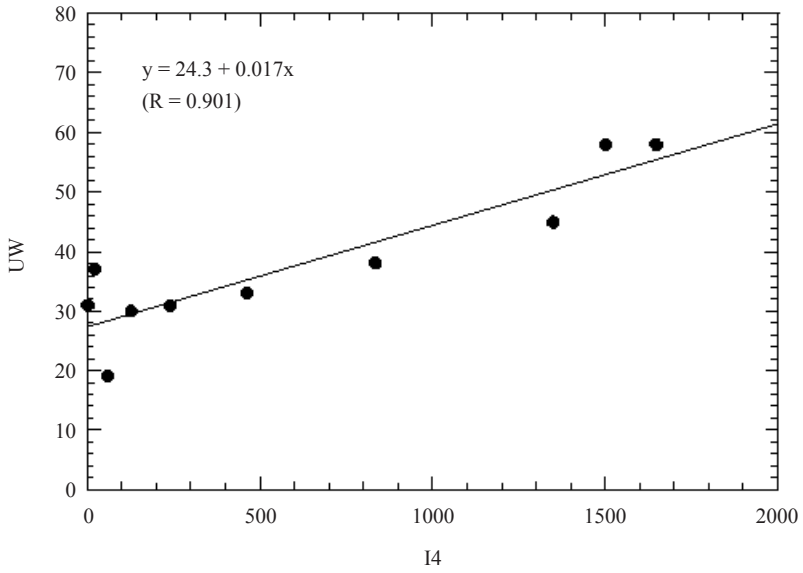

Figure 5. Relationships between the keywords 'University Website (UW) (380 papers)' and Industry 4.0 (I4) (6235 papers) indexed in Scopus from 2012 to 2021, as searched on 13 March 2022. The line was based on the linear equation.

3.2 *Secondly, there is a total of 24 countries and 1 region (Latin America) found in this review, with Indonesia leading the list with 8 publications*

Table 1. Research findings focussed on university's websites from different countries reviewed based on the 2021 Scopus database.

No.	Research findings	Target group/ Country	Ref.
Indonesia			
1	Based on User Experience questionnaire, it could be concluded that users' motivation to open and contribute to revisit websites increases.	Public users/ Indonesia	[8]
2	Indicating that the keyword usage level domain variable was the most important variable, with a good effect on the visibility of university website.	Public users/ Indonesia	[33]
3	Found that smart seminar application had been effective in the learning of a university	Students/ Indonesia	[34]
4	Identifying that the usability and service interaction aspects of the university website had quite significant gaps between perceived and ideal qualities.	Students/ Indonesia	[35]
5	A total 36 services provided optimal information for the users of the Engineering Faculty in the University of Indonesia's website.	Public users/ Indonesia	[21]
6	Improving the evaluation for the university selection of new student admissions website's development to meet user expectations.	Public users/ Indonesia	[22]
7	Found that the ranking of university websites based on usability criteria could provide significant results similar to the ranking results with three standards released by Webometrics.	Indonesia	[16]
8	Facilitating students or lecturers as users and the secretariat of the lab as the admin to record and record computer borrowing data that occurred in the information system laboratory.	All users/ Indonesia	[20]
India			
9	Listing the errors that will benefit user groups having different disabilities when corrected, feature metrics elements, and useful suggestions for improving the accessibility of these websites.	Public users/India	[10]
10	Looking from the students' perspective and to find its association with satisfaction.	Students/India	[25]
11	Introducing creative online sources and services and updates of news and research information.	Public users/India	[30]
12	Improving the University websites efficiency in the admission decision-making process.	Students/India	[26]
China			
13	Improvement of the brand awareness of private colleges and universities, with recommended measures in the website operations.	Public users/ China	[9]
14	Provided a reference for the future design of university portal based on usability evaluation.	Public users/ China	[23]
15	Found no significant difference in the using texts and visual images on their websites of four universities in China and South Korea that seek to become World-class universities.	Public users/ China and South Korea	[3]
USA			
16	Developing and supporting policies and incentives to promote Corporate Social Responsibility disclosure and thus attract new students and meet social expectations about the ethical behaviour of university websites.	Public users/USA	[37]
17	Served as a benchmarking study to investigate the types and availability of resources available to postdoctoral scholars on university websites.	postdoctoral scholars/USA	[38]
18	Identifying the problems to provide complete, factual, and readily accessible information that will allow students and their counsellors to make informed college comparisons and choices.	Students/USA	[39]

Table 1. (cont.)

No.	Research findings	Target group/ Country	Ref.
Italy			
19	Found that public universities are still struggling to satisfy all its requirements to public users. Therefore, improvement of university websites are necessary.	Public users/Italy	[17]
20	Highlighting the elements of the webpages that can be modified to improve web usability.	Public users/Italy	[24]
Malaysia			
21	Identifying the lack of awareness and appreciation on the institutional mechanisms and lack of formal pressure from the relevant authority, regarding the fraud prevention disclosure on the Malaysian public universities' websites	Public users/ Malaysia	[40]
22	Analysing other web-based data could provide additional insights that may be beneficial for webometrics studies and identify university website' characteristics.	Malaysia (UTM)	[4]
Others			
23	Found that the need for information during the pandemic decreases as time passes, and even new emergencies such as the beginning of the second wave of COVID-19 only affect this behavioral pattern to a minor extent.	Public users/ Germany	[28]
24	Identifying the need for Turkish universities to devote more resources to making their websites more accessible, usable, high-quality performance, and readable for all their potential users.	Public users/ Turkey	[5]
25	Recommendations to develop a useable design to add videos to university websites.	Students/UK and Iraq	[13]
26	Helping university administrators to improve the quality and effectiveness of online environmental communications by the development of an operational benchmarking tool via the university websites.	University administrators/ Latin American universities	[41]
27	Validation of the effectiveness of the developed tool in accessing academic website.	Academicians/ Bangladesh	[11]
28	Recommendation to implement several strategies to improve Webometrics rankings, especially visibility.	Public users/ Timor Leste	[29]
29	Improvement of a website and the requirements of special students is a concern for all educational institutions.	Special students/ UAE	[14]
30	Recommendation of the institution should focus on the quality level of information and areas of strength rather than quantity besides employing their mission statements to generate realistic directions and purposes that are tailored to society's needs.	Public users/ Saudi Arabia	[15]
31	Suggesting the usefulness of story-based content supported by online ads to attract international student applications.	Students/Malta	[19]
32	Investigated how self-mention is represented in research sections of university websites in Estonia and the United Kingdom, that can improve the university visibility.	Public users/ Estonia and the United Kingdom	[42]
33	Concluding that universities project their quality, informally, by invoking narratives concerning the future and uncertainty, employability, infrastructure, as well as indicators and numbers other than rankings	South Africa	[43]
34	Recommendations were given on how to improve some of the elements on websites in order to make these websites more accessible in accordance with the standards related to this topic.	Bosnia and Herzegovina	[7]
35	Proposed a new ranking system based on the website quality factors and traffic evaluation.	top-ranked world universities	[44]
36	Introduction of a model based on multi-criteria decision-making for measuring university website's evaluation indicators to help university website designers become aware of weaknesses of web designs and use it to strengthen academic websites.	Website designers/Iran	[6]
37	Through the websites, the universities had given an image of a key institution in social changes, as well as the support and benefits that it can bring from the fulfilling of their social responsibility through the university-society relationship.	Public users/ Spain and Brazil	[27]
38	Proposing the binary matrices as an effective too for higher education managers and experts focusing on specific regions and social media to influence the universities' reputation in the World University Rankings	Universities of the world	[32]
39	Suggesting that the accessibility level of websites of leading educational institutions websites has been determined through analysing compliance with the levels of accessibility under WCAG 2.1.	Ukraine	[45]

The results of the study of UWs from different countries reviewed based on the Scopus 2021 database are shown in Table 1. In general, there were a total of 23 countries and 1 region (Latin America). Indonesia led the list with 8 publications, followed by India (4), China (3), the United States (3), Italy (2), and Malaysia (2), while Germany, Bangladesh, South Korea, Estonia, the United Kingdom, Saudi Arabia, Timor-Leste, Turkey, the United Arab Emirates, Malta, Iraq, South Africa, Bosnia and Herzegovina, Iran, Spain, and Brazil, as well as Ukraine, each had 1 publication. In addition, there was one publication on the world's best universities and another on the world's universities, without specifying which country.

3.2.1 *Indonesia*

In 2021, Indonesia presented a GDP per capita of 12,967 USD (ranked 103rd in the world) [46], with a total number of universities of 2,595 as ranked third in the world, as of July 2021 [47].

To attract users, Budiman and Akhlis [8] created a university online with push notifications. They explored how the use of push alerts might alter online users' motivation and interest. Finally, they found that respondents' motivation to open and revisit websites improved due to the questionnaires analyzed with the User Experience Questionnaire. Hamid et al. [34] used an experimental approach to assess and test the usefulness of the Smart Seminar application in learning Islamic religion through a case study at Raharja University. They found that using the Smart Seminar app to learn Islam at Raharja University is really successful.

Jati et al. [33] investigated the factors that influence a website's visibility in a search engine and calculated the visibility ranking based on the variables that influence it. The results of the weighting procedure suggested that the domain-level keyword usage variable was the most important variable, while domain-level link authority characteristics had the least effect on a website's visibility, with Yogyakarta State University having the top rating. Because CRITIC's method was highly clear and concise, it might be represented with any criteria and choices that the problem possesses.

Pradana et al. [35] looked at the students' perceptions of the quality of Telkom University's online learning website. They used the website quality method's question items and significance analysis to analyze the results (gap analysis). They found that the website's usability and service interaction had large gaps between perceived and ideal quality. Suzianti et al. [21] investigated the researcher using the University of Indonesia's Faculty of Engineering website. The website was revamped utilizing the fuzzy Delphi approach to decide the media type for presenting each service and the layout of each web page to increase its usability. Furthermore, fuzzy cognitive maps were employed to model the relationships between each service and media type in this study. As a consequence, a prototype of 12 web pages for the website of the Faculty of Technology at the University of Indonesia was created, with a total of 36 services that provided the user with the most up-to-date information.

Utami et al. [22] employed a mix of WebQual 4.0 and Importance Performance Analysis methods to analyze the quality of Sebelas Maret University's New Student Selection website to assess and improve UW performance. Their study found that UW's gap analysis had a negative value in all aspects. The aspects that needed to be improved were the UW's design, website navigation, and presentation of detailed and up-to-date information. Their findings can be used as a standard for the future improvement of UW.

The impact of website usability on Webometrics ranking was explored by Anistyasari et al. [16]. This study used 75 websites from Indonesian institutions as a sample. Data was collected using various research devices, including an online checker. They found that rating UWs based on usability factors produced significant results comparable to ranking results based on three Webometrics standards.

At the University Information Systems Laboratory XYZ, Nurzaman and Legowo [20] set out to study and build a web-based computer rental application system. They came to the conclusion that this analysis and design would make it easier for students or teachers to capture and record computer rental data created in the information systems lab, as well as the lab secretary as an administrator.

3.2.2 *India*

In 2021, India got a GDP per capita of 7,314 USD (ranked 129th in the world [15] but India ranked 1st in the world in terms of the total number of universities with 5288 as of July 2021 [47]. Gupta and Singh [10] examined the accessibility of 27 UWs in the Indian state of Punjab. The overall results of the analysis called for further improvements

in the accessibility of these websites. The paper included a list of errors that user groups with various disabilities would benefit from fixing, elements of functional metrics, and valuable suggestions for improving the accessibility of these websites so that the information provided by these websites reaches their audiences without barriers.

Karani et al. [25] examined the usability of Gujarat Technological UW from the students' perspective and scrutinized its association with satisfaction. They found that all four dimensions of website usability were positively related to satisfaction. In contrast, content, organization, and readability influenced satisfaction, followed by user interface design, performance and effectiveness, and navigation and links were negatively related to satisfaction. They strongly recommended that the UW be kept up-to-date, well-organized, and understandable to all users including students to amplify satisfaction with the UW.

The webometric characteristics of the fifteen Open Universities in India were investigated by Patel and Vyas (2021) [36]. Various webometric parameters were used to rate the UWs. The domain age, domain extension, internal linking, external linking, page speed, web impact factors, WISER index rating, social media connection, and Alexa ranking of the websites were all calculated in the study. They recommended that open UWs should include unique online sources and services, as well as news and research information updates, to attract more external connections and web impact elements.

An exploratory study was undertaken by Bapat et al. [26] to see how important UWs were in the admissions decision-making process. The usefulness of the UW for admissions decisions was substantially associated with the wealth of one or both parents, according to hypothesis testing. They came to the conclusion that faculty profiles, as well as student employability and internship possibilities, played a big role in the admissions process.

3.2.3 *China*

China had a GDP per capita of 19,090 USD in 2021 (ranked 75th in the world [46]) with a total number of universities of 2565 ranked 4th in the world as of July 2021 [47].

Chen et al. [9] used case analysis to collect link index and traffic index data from private UWs in China, conduct relevant analysis, sort out the relationship between link indicators and traffic indicators, and interpret the strategies for brand promotion of private colleges and universities. Xiong et al. [23] used usability testing to guide the improvement of a university portal website. To begin, this study proposes five indicators of university portal quality assessment based on the previous theory: accessibility, content, design, navigation, and organization. They gave ideas and website optimization redesign based on user input and data analysis. Based on usability testing, they gave a reference for the future design of the university portal.

Bae et al. [3] examined the websites of four Chinese and South Korean colleges that aspire to be world-class. They looked at how these colleges present themselves on their websites using text and visual representations. They found that all institutions utilized comparable wording and images to convey their world-class reputation, as well as visuals demonstrating their worldwide participation and research achievements.

3.2.4 *USA*

USA ranked 8th in the world based on GDP per capita of 69,375 USD in 2021 [41] with a total number of universities of 3216 ranked 1st in the world, as of July 2021 [47].

Sanchez et al. [37] studied data on corporate social responsibility (CSR) provided voluntarily by leading universities in the United States. They found that universities are dedicated to circulating information on CSR and that a university's size, affiliation, public/private status, and ranking position are the most influential factors in its online disclosure of general CSR information on UWs. They claimed that their findings benefited university administrators because they focused on the importance of developing and supporting policies and incentives to encourage CSR disclosure to attract new students and meet social expectations about university ethics.

Perna et al. [39] used web sphere analysis to study the usability and utility of cost-of-attendance information offered by selected 4-year colleges and universities via their net price calculators and cost-related UWs. They found that some universities were not only violating federal net price calculator mandates but also ignoring their ethical obligation, as stated by the National Association of College Admission Counseling.

As benchmarking research, Zerbe et al. [38] looked at the variety and availability of resources available to

postdoctoral scholars on UWs. They planned to employ text analysis technologies to categorize UWs to determine whether or not different types of postdoctoral support are available at different universities.

3.2.5 *Italy*

Italy presented the GDP per capita of 45,267 USD in 2021 (ranked 32nd in the world) [46] with a total number of universities 239 ranked 23rd in the world, as of July 2021 [47].

Barricelli et al. [17] investigated the accessibility of Italian public UWs, focusing on their compliance with the Stanca Act. This is intended to assess its impact. Even though the Stanca Act was 15 years old, they concluded that Italian public universities are still struggling to meet all of the standards of UWs.

Zammarchi et al. [24] studied the web usability of the University of Cagliari's website using qualitative and quantitative methodologies to analyze eye-tracking data. They concluded that the information needed to complete the tasks could be easily acquired by students with limited prior experience with the website. The key point behind their findings was that it allowed them to flag page features that may be changed to improve web usability.

3.2.6 *Malaysia*

Malaysia had a GDP per capita of 29,048 USD in 2021 (ranked 57th in the world [46]). with a total number of universities of 374 ranked 15th in the world, as of July 2021 [47].

Madi et al. [40] investigated fraud prevention information on Malaysian public UWs. They reported that there were eight areas of fraud prevention policies, responses, initiatives, and processes that were not adequately communicated. Lack of institutional understanding and appreciation, as well as a lack of formal pressure from the competent authority, could be contributing causes. Because of the low level of the disclosure using university fraud prevention disclosure index, Malaysian public institutions will be forced to take active measures to encourage openness and good governance among university employees, assisting the government in tackling the country's fraud problem.

Sharul et al. [4] investigated the development of a unique framework that used machine learning approaches based on webometrics and web usability to automatically classify web pages of academic websites. The framework briefly explained how it may be used to classify web data, remove irrelevant content, and conserve storage space. The findings can also be applied to other web-based data to provide further insights for webometrics studies and to learn about UWs.

3.2.7 *Other countries and regions*

Akgül [5] studied all Turkish government and private UWs. Out of 110 state UWs and 69 private UWs, they found that only 10 state UWs and four private UWs accomplished compliance Level A. They also found poor performance, usability, and readability. This indicated the need for improvement of Turkish UWs in terms of accessibility, usability, quality performance, and readability for all users.

Alfayez [13] conducted a qualitative research project to answer the following questions: "How have instructional films (lectures/tutorials) broadcast on YouTube influenced university students' studies at both the postgraduate and undergraduate levels?" "Would it be more appropriate to post these types of films on a UW?" and "Would it be more appropriate to post these types of videos on a UW?" They wanted to learn about students' experiences with online educational films at two institutions (one a top-ranked university and the other from a poor country) and assess how these videos affect their academics. They gave a few suggestions for creating a user-friendly design for adding videos to UWs.

Rashida et al. [11] developed a multi-method approach to assessing the quality of academic websites in the context of Bangladeshi universities. They conducted a questionnaire-based statistical evaluation of many universities' academic websites to get input from their respective users. Then, based on the survey results, a ranked list is constructed that was nearly identical to the ranked list issued by university ranking systems. This demonstrated the utility of our built technique for gaining access to academic websites.

Wahyuningrum et al. [29] looked into how the revised web impact factor (R-WIF) influences webometrics and what aspects might help improve the quality of a UW. They used the R-WIF to assess the relative status of academic sites at seven universities in Timor Leste. They found that, while some colleges had boosted their backlink count, the webometrics university ranking prioritizes backlinks from high-authority sites like.edu and.gov. The correlation value

between R-WIF and Webometrics was 0.464, which showed a moderate relationship. To increase Webometrics rankings, particularly visibility, universities in Timor Leste must execute a number of initiatives.

Ali [14] compared the accessibility of UWs in the UAE to the W3C standard and recommended how to improve the degree of e-accessibility for students with special needs, as it permitted them to access a wider choice of educational materials. This was necessary for a UW to meet the needs and requests of exceptional students, which is a concern shared by all educational institutions.

Regarding social conceptions, Al-Qahtani [15] examined and analyzed the various discourses employed to depict Saudi institutions on their websites. They found that universities promoted themselves using a consistent, systematic promotional discourse that emphasized uniqueness and prestige. They revealed that the UW's representation of gender, race and economic position was lacking. They suggested that instead of focusing on quantity, these institutions should concentrate on the quality of information and their areas of strength. Furthermore, they recommended that their mission statements establish realistic goals and objectives that are adapted to the demands of society.

Using an experimental methodology, Cassar and Caruana [19] provided hypotheses concerning the impact of these two categories of content on website stickiness and the role of gender. Their findings revealed that story-based content had higher stickiness and that there were gender disparities between the two categories of content. Their findings were supported by the narrative paradigm theory, which claims that storytelling is more effective than argument-based communication.

Estonia and the United Kingdom (UK), Kapranov [42] examined how self-mention was portrayed in the research sections of UWs. The study's corpus comprised research sections from the University of Cambridge (UK) and the University of Tartu's official websites (Estonia). According to the quantitative study, Kapranov [42] found that the pronoun "we" was the most frequent self-mention per 1000 words on UWs in Estonia and the UK.

Through a benchmarking operational tool, Fernández-Vázquez [41] attempted to investigate the current condition of website environmental communications in Latin American colleges. According to Sanchez et al. (2021 in USA's UW) [37], the study looked at how these colleges communicated their environmental policies as a kind of corporate social responsibility to improve their public image. They found that 59 percent of institutions had established environmental websites. Many of them, however, offer inadequate content and engagement. Several objective criteria used to assess the effectiveness of online environmental communications yielded low rankings for Latin American colleges. The findings could be useful to university administrators in terms of improving the quality and efficacy of online environmental messaging. Further comparison studies were prompted by developing an operational benchmarking tool, which may add to a broader picture of environmental communications.

Ceke and Kunosic [7] examined UWs in Bosnia and Herzegovina in terms of accessibility on the one hand, and their international standing in terms of the Webometrics list of universities on the other. They suggested modifying some of the aspects of websites to make them more accessible by the relevant standards.

Farashi and Bashirian [44] proposed a new ranking mechanism based on website quality factors and traffic measurement. They concentrated on top-ranked universities since they are often held up as models for lower-ranked institutions. They found that the size of a website's total traffic was connected to its Webometrics rank. The proposed ranking algorithm could also predict Webometrics ranking with up to 69 per cent accuracy utilizing the weighted value of website quality and traffic data. Although the approach was created for university rankings, if a sufficient cost function for the genetics algorithm framework could be built, it might be applied to rank other sorts of institutions or organizations. Mamaghani and Montazer [6] established a multi-criteria decision-making technique for measuring UW assessment indicators. The "accuracy" index was found to be the most important, while the "link error" indicator was shown to be the least essential. Their findings could aid UW designers in recognizing web design flaws and using that information to improve academic websites.

Medina-González et al. [27] conducted a comparative analysis of information and knowledge that is communicated about COVID-19 on the websites of Spanish and Brazilian institutions. Despite the differences in circumstances, they found that the convergences between the communicative practices of the investigated sites stem mostly from the broadcast of content on initiatives and projects, as well as public participation options. Universities had presented an image of a vital institution in social transformations through these communication venues, as well as the support and advantages that can come from fulfilling their social responsibilities through the university-society relationship.

Moskovkin et al. [32] studied how the languages of UWs and social networks could influence the university's

reputation in the World University Rankings. By merging the union of sets of university names from Times Higher Education, QS World University Ranking, and Academic Ranking of World Universities of 2018, the World's Top 100 Universities Rankings obtained a collection of 146 universities. They found that more than half of the universities polled had multilingual websites. They concluded that binary matrices had shown to be useful for higher education management and experts concentrating on specific regions and social media.

Sashnova et al. [45] analyzed compliance with WCAG 2.1 levels of accessibility to assess the accessibility level of the websites of prominent educational institutions. The findings allowed a hierarchical model of accessibility evaluation to be developed, considering both criterion and sub-criteria aspects. They noted that the websites of the following educational institutions were of good quality: 3% for the University of Michigan Ann Arbor and 6% for the University of Cambridge, with the rest ranging from 13% to 38%. For every 100 scanned pages, the website of U701 University has a minimum of 9 percent accessibility, 2% compatibility, and 31% conformance with web standards. The subject of accessibility is discussed on 35 pages at the Massachusetts Institute of Technology. 22 pages of the National Technical University "Ihor Sikorskyi Kyiv Polytechnic Institute" are inaccessible. Lviv Polytechnic National University's website has a low accessibility level; it contains 80 pages with issues for users, especially those with impairments. The suggested hierarchical model of website quality evaluation by criteria and sub-criteria elements will make websites more accessible to users, increase access regardless of functional problems, and reduce the time and effort required to find information.

Srivastava [43] emphasized the importance of marketers on how colleges project multiple definitions of 'quality,' particularly to their prospective consumers. They looked at how marketing imperatives impact discourse and how university marketers and leadership/management depict 'quality' at universities. According to the findings, universities were not passive entities that merely respond to the needs of numerous stakeholders in higher education. Instead, they actively developed their own quality narratives and applied marketing skills. Universities, in particular, informally represent their excellence by using narratives about the future and uncertainties, employability, infrastructure, and metrics and numbers other than rankings.

Based on all the papers reviewed in Table 1, they aimed to identify the obstacles and recommended ways and room for future improvements for all users regarding their university's websites.

It can be inferred that the number of papers indexed in Scopus based on the country is not related to its GDP and the number of universities in the country. The number of published papers could be related to the number of researchers who are working in the UWs and the university's emphasis to improve its degree of usability. Of course, even the high-ranked universities with their constant improvements of their UWs have yet to publish their successful experience could not be ruled out.

It is undeniable that the advent of digital technology that allows anyone to easily share knowledge via the Internet is referred to as the digital age. The visibility and accessibility of content on a UW must be upgraded for it to play a greater role and attract potential users, especially potential new students [23]. Since a UW can offer its own set of benefits for a university, such as serving as a promotional tool, displaying information, and providing online services [22], the constant improvement of UW is almost a must.

4. Limitations of the study

This study aims to review the publications indexed in the Scopus database in 2021 using the search term 'University Websites' and to synthesize the main information being discussed in the manuscripts. Nevertheless, it has limitations such as it is focused on the Scopus database and it will be better if expand the review search to another search database. Then, this study only uses published papers from 1996 to 2021. Moreover, it needs some experiments using formal statistics to ensure those key success factors.

5. Conclusions

This comprehensive systematic mapping study presents the publications indexed in the Scopus database in 2021 using the search term 'University Websites'. According to the results of this review, user-based usability evaluation

methods were used to evaluate the usability of university websites. Three key themes emerged from the current systematic review. To begin with, the number of publications on university websites will likely increase shortly, in line with the global adoption of Industry 4.0. Therefore, further studies to incorporate artificial intelligence into UWs should be carried out to provide convenience to the users. Second, this evaluation includes an analysis of publications from 24 countries among which Indonesia leads the list with 8 publications followed by India (4), China (3), the United States (3), Italy (2), and Malaysia (2). The other countries (15) had 1 publication each. Finally, all of the papers tried to identify the barriers to all users' using their university's websites, as well as suggest strategies and areas for future improvements. It is also ideal to study the suitability and practicability of the strategies presented in this study to be incorporated into UWs of different countries in the future due to the fact that the construction of the interface was influenced by cultural determinants, as mentioned earlier. This review can shed some light and provide evidence that constant improvement of UWs is worthwhile and its investment pays off.

6. Future work

Another issue that could be elaborated on in the article with a view to conduct future research is the relation between Industry 4.0, especially artificial intelligence technologies, and ways how UW can be developed by using for example bots and chatbots in the process of building UW sites. The research's scope will expand as a result. Future studies might possibly employ different analytical techniques. There are other techniques, such as the SWOT analysis framework, which classifies connected aspects based on their strengths, weaknesses, opportunities, and threats.

Conflict of interest

The authors declare no competing financial interest.

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