Awareness, familiarity and usage of traditional research metrics and altmetrics among academics in Malaysia

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ABSTRACT

The growing necessity to improve the evaluation methods of research impact as scholarly communication has progressed increasingly online. Studies investigating awareness and usage of social media among academics have been increasing. However, only limited studies focus on the familiarity and usage of research metrics among them. The aim of the study was to investigate the relationship between awareness, familiarity, and usage, as well as hindrances in using research metrics among academics in Malaysia. A total of 344 individuals took part in an online survey and the data were analyzed using Partial Least Squares-Structural Equation Modeling (PLS-SEM) to examine the postulated hypotheses. Our results revealed that familiarity is the only predictor associated with the usage of research metrics among academics with 62.7% of variance explained. Seniority did not mediate the relationship between familiarity and awareness to the usage of research metrics among academics. In conclusion, altmetrics have the potential to develop as complements to traditional metrics and to provide a useful insight into new impact modes not included in existing measures.

Keywords: Altmetrics; Social media usage; Research metrics; Citation-based metrics; Malaysia

INTRODUCTION

Research metrics are widely defined as quantitative indicators or measures used to help assess the quality and impact of research outputs (Grech and Rizk 2018). Researchers often employ research metrics as the fundamental tools to measure performance, both at journal- and author-level. Traditional metrics or citation-based metrics used to be the only method available to assess research impact and have been used for ages till today. For traditional metrics, the major focus is how frequent the journals are cited in other scholarly

articles (Bakker et al. 2020). Examples of traditional metrics include h-index, CiteScore, and Journal Impact Factor (JIF). On the other hand, alternative metrics, which is also known as altmetrics, are the latest research metrics based on the Internet for evaluating and appraising research (Sutton, Miles and Konkiel 2019).

Altmetrics is a relatively new tool for the assessment of research impact. In year 2010, Jason Priem, a doctoral student specializing in information science in the University of North Carolina, United States, coined the term "altmetrics" (alternative metrics). Altmetrics can be traced from various aspects, which include the number of bookmarks, the number of likes, shares, and the mentions on social media platforms such as Twitter, Facebook, and YouTube. However, altmetrics should be interpreted with caution as sharing an article or discussing it on social networks does not guarantee it is of high quality (Crotty 2007; García-Villar 2021).

Traditional metrics, for instance, the impact factor (IF) is a targeted yet specific research metric. Traditional metrics focus on the actions and preferences of researchers, but not the public, unlike what is done by altmetrics (Beall 2015). In other words, traditional metrics are more professional and specific in indicating the research impact of journals as compared to altmetrics, which are more diverse and general. In contrast, from altmetrics, we get to understand how frequent the journals are being discussed, shared, and mentioned on the Internet by the public around the world, not only just researchers (Sutton, Miles and Konkiel 2019).

Altmetrics have been proposed as a way to assess the societal impact of research (García-Villar 2021; Thelwall 2020). Holmberg et al. (2019) has discussed the different types of impact or influence that research can have on the society, including the potential of altmetrics to capture and measure this societal impact or social impact. García-Villar (2021) has recommended that altmetrics should be used as a complementary tool to traditional metrics, rather than replacing traditional metrics. By utilizing both metrics, we can appraise a journal from both researchers' and societal perspective, to obtain convincing evidence of a research impact of a publication.

To date, the use of altmetrics in reviewing research impact remains controversial. Certain experts refer altmetrics as "attention metrics" as they essentially measure attention of the public on the journals, but not evaluating the reliability and validity of the data, methodologies or findings included in the journals. Experts claim that altmetrics do not serve the certification function of scholarship, a function that establishes the validity of a research (Beall 2015). However, some scholars supported the use of altmetrics in evaluating research impact as expert judgement of research impact which applies traditional metrics is time consuming and complicated (Thelwall 2020). Altmetrics have the advantage of presenting impact data within a shorter period of time. Upon the release of a publication, altmetrics only require days, or even hours to produce the research impact data (Sutton, Miles and Konkiel 2018).

As the dissemination of scholarly outputs via online has gotten faster and easier, the way of evaluating research outputs has gradually transformed and this causes the studies investigating the awareness and usage of social media among academics to be on the rise (Aung, Erdt and Theng 2017). The number of studies focusing on examining the familiarity and usage of research metrics among academics has, however, remained low (Aung et al. 2019). Thus, our study investigated the relationship between awareness, familiarity, and

usage of research metrics among academics and we determined if academic seniority would moderate the relationship among the variables.

LITERATURE REVIEW

Uses of Metrics in Research Assessment and Academic Promotion

Assessing scholars is a focal point of decision-making in the promotion and tenure procedure where judgments need to be made by institutions with limited time and budgets. Usually, assessment is done by evaluating factors that are easily determined, such as the number and amount of funded grants and the number and citations of published literatures (Moher et al. 2018). Habitually, scholars concentrate on research and education. However, the last decade has witnessed the emergence of novel areas of advancement such as innovation, quality enhancement, informatics, and lately, digital scholarship. Nowadays, many academic institutions have started considering these fields for academic promotion and tenure (Cabrera, Roy and Chilsom 2018).

The importance of traditional metrics in research assessment centered around explicit evidence that citation-based metrics serve as an unbiased and immediate evaluation. Traditional metrics as a measure of research impact are playing a significant role in appraising study to distinguish those potentially important literature which will bring an impact to the field of study, from the unimportant or unimpactful one (Ferrier-Watson 2019).

On the other hand, altmetrics contribute to the assessment of research where they serve as an indicator of engagement, and they relate the literature more to public discourse rather than professional discussion among themselves. Certain experts recommend that altmetrics to be included as the evaluation tools of research and a wide range of sources should be accepted to contribute to research assessment (Ferrier-Watson 2019).

Uses of Metrics Beyond Research Assessment and Academic Promotion

There are two major justifications for academics to use traditional metrics outside of academic promotion and research assessment. The first reason is to gauge the impact of their own research output (Ferrier-Watson 2019). Certain scholars would like to consistently update themselves as to what extend their study is bringing impact to the field. The urge to explore may be just out of their instinctive and professional interest. The second reason is to evaluate the impact of a literature in relation to publishing (Ferrier-Watson 2019).

Beyond academic promotion and research assessment, the second reason of using altmetrics is to gauge the degree of engagement outside the academia world (Ferrier-Watson 2019). Some academics would like to assess how much their paper are being shared and discussed on the Internet.

Traditional Metrics

For ages, traditional citation-based metrics such as h-index and JIF are frequently used in appraising the scholarly impact of academic literature on a scientific discourse (Sommer 2018). The first Science Citation Index was launched by the Institute for Scientific Information (ISI) in the 1960s and has led to the establishment of a novel approach of indexing published literature. Citation index offers a valuable judgement regarding the impact of an academic output. Theoretically, the higher the number of citations received

by the paper, the greater the academic impact of the literature. Citation index clarifies the doubts of audiences concerning the sources of information available in a paper by showing the citations between publications (Noah, Pearce and Modgil 2020). However, citation-based metrics such as JIF is not perfect and comes with certain limitations. It can be influenced and biased intentionally or otherwise by many factors (Mech et al. 2020).

Citation-based metrics are widely used across the globe in various decision-making activities. For instance, in Australia, academics often employ JIF and h-index in their assessment of research impact (Aung 2016). In addition, a study performed by Wilsdon and his colleagues has shown that traditional metrics were incorporated by countries such as Italy, Denmark, and Netherlands in their national research assessment program (Bakker et al. 2020). Another study conducted by DeSanto and Nichols at the University of Vermont, United States, found that faculties in university necessitate and stress on traditional scholarly metrics in their promotion and tenure dossier (DeSanto and Nichols 2017).

Altmetrics

In today's modern era, "if something cannot be found on any social media platforms, it does not seem to be exist" (Donato 2014, p. 1). The broad use of social media promotes the emergence of alternative metrics, which is a brand-new tool for the assessment of research impact (Mamtora and Haddow 2015). Alternative metrics appraise the research impact of papers on public discourse. Altmetrics are online products which trace the public attention and the research outputs obtained online (Sommer 2018). Altmetrics are developed by Altmetric.org, a website created by Priem and his partners in October 2010 (Roemer and Borchardt 2015). According to Priem, altmetrics are tactics used to discover those previously invisible traces of research impact by detecting online activity to record informal use or impact such as the number of views on YouTube, number of likes on LinkedIn, and citations in blogs and news articles (Ferrier-Watson 2019). Altmetrics track article-level metrics across various platforms. Hence, they have the ability of revealing how academics are engaged with articles outside citations besides ensuring that academics get recognition for bringing an impact to public discourse and knowledge (Sommer 2018).

Altmetrics regularly adapt to evolving data sources (Tattersall and Carroll 2018). To dates, Altmetric.com, PlumX, and ImpactStory are among the leading altmetrics data providers. In general, Altmetric.com and PlumX emphasize on harvesting and supplying data for institutions such as publishers, libraries, or higher education institutions. As of June 2017, Altmetric.com has collected over 10 million academic outputs in the Altmetric Explorer. PlumX has a comparable system as the Altmetric.com where the PlumX altmetrics dashboard is an online system available to envision the impact of the academics from institutions of higher education in altmetrics sources and bibliometric databases (Fraumann 2017). On the other hand, ImpactStory's priority is on an individual scholar who wish to incorporate altmetrics data in his or her curriculum vitae (CV) (Peters et al. 2016).

Like any other tool, there are pros and cons of employing altmetrics over citation-based metrics in reviewing impact of scholarly output. The advantages of altmetrics include their ability of giving early impact evidence, immediacy, and capability of tracing research impact beyond the academy. The disadvantages of altmetrics include ethical issue, gaming, incentivize production of papers which are particularly written to attract attention and representativeness of information in terms of who is using the resources.

The Pros and Cons of Altmetrics

In practice, the leading advantage of altmetrics is their capability of giving early impact evidence (Thelwall 2020). Academics may consult altmetrics to examine if their recently published articles are receiving any public attention, either for personal feedback or impact evidence to be presented in their CV. Early impact evidence obtained from altmetrics is useful for research appraisals as well, where they shorten the time gap between conducting research and evaluation of research. This allows the latest study to be assessed besides allowing indicators in decision-making at a point where scholarly outputs are still developing and are too early to have attracted traditional citations (Thelwall 2020).

Another remarkable advantage of altmetrics is their immediacy (Sutton 2014). Altmetrics are gathered from information that is dispersed rapidly on the social web with the aid of technological advances. As a result, altmetrics attention scores will have a significant increase within a short period of time after publication, as compared to citation-based metrics which will have a more delayed effect (Noah, Pearce and Modgil 2020). In other words, altmetrics offer reflections on what is happening with the journal currently and therefore helping academics to get a clearer picture of the reach and impact of their scholarly output, instead of wasting time debating about the JIF, which reveals the activity of the research from previous year (Williams 2017). By employing altmetrics, we can easily crowdsource peer-review. Instead of waiting for months, or even years for few opinions, impact of the article may be evaluated by thousands of dialogues, views, downloads, and bookmarks perhaps just within a week.

A quirk of altmetrics is ethical issue. Regardless of whether the Internet user is aware, his or her online data is consistently tracked, and this contributes to the potential ethical issues (Fraumann 2018). In this digital era, majority of the community still retain strong perceptions and expectations of privacy and confidentiality even though they involve actively in various social media platforms (Markham and Buchanan 2012). Consequently, altmetrics give rise to the conflict of ethical issue as they include private and confidential information of users. In addition, each individual Internet user is not noticeable in the bulky, aggregated data sets of altmetrics. Certain users might give their consent about the data collection, but some might not. Giving of consent is subjective as it hugely depends on personal assumptions and cultural practices.

Gaming is another critical concern which will compromise the reliability and validity of altmetrics (Xu 2018). Gaming of altmetrics is defined as the conduct that is meant to purposely manipulate altmetrics, generally for advantage of individual, which results in an unfair scoring (Htoo and Jin-Cheon 2017). The altmetrics attention score can be easily manipulated. Certain experts explain that it is still premature for altmetrics to take part in appraising research impact as they are easily gamed. There are possibilities where scholars will pay for Facebook likes, tweets and followers, and they can even manually increase the views or downloads of their articles (Beall 2015). Various tricks of gaming undermine the authority and credibility of altmetrics as a performance measure (Cheung 2013).

Utilization of altmetrics as research impact assessing tool may give illusion to certain academics where they are writing to attract attention from audiences, but not focusing on the quality of their work (Bakker et al. 2020). Altmetrics scoring may encourage the emergence of undesired competition where researchers may treat it as a modern form of headline chasing by producing low-quality or unimpactful literature merely to outcompete the others. In other words, the quality of work will be sacrificed. In short, altmetrics will be the tail wagging the dog (Beall 2015). With this mixed pros and cons of the usage of

altmetrics, it is certainly a need to examine the awareness, familiarity, and usage of traditional research metrics and altmetrics among the Malaysian academics.

OBJECTIVES

The aim of this study was to investigate the level of awareness, familiarity, and usage of traditional research metrics and altmetrics among the academics in Malaysia. Figure 1 shows the research framework outlined in this study. The objectives of this study were to:
(a) investigate the relationship between awareness, familiarity, and usage of traditional metrics and altmetrics among the academics in Malaysia; and
(b) examine the role of the years of teaching as the mediator among awareness, familiarity, and usage of traditional metrics and altmetrics. The below hypotheses were proposed:

H1: There is a positive relationship between awareness on research metrics and usage of research metrics.
H2: There is a positive relationship between familiarity with research metrics and usage of research metrics.
H3: Seniority (the year of teaching) positively mediates the relationship between awareness, familiarity, and usage of research metrics.

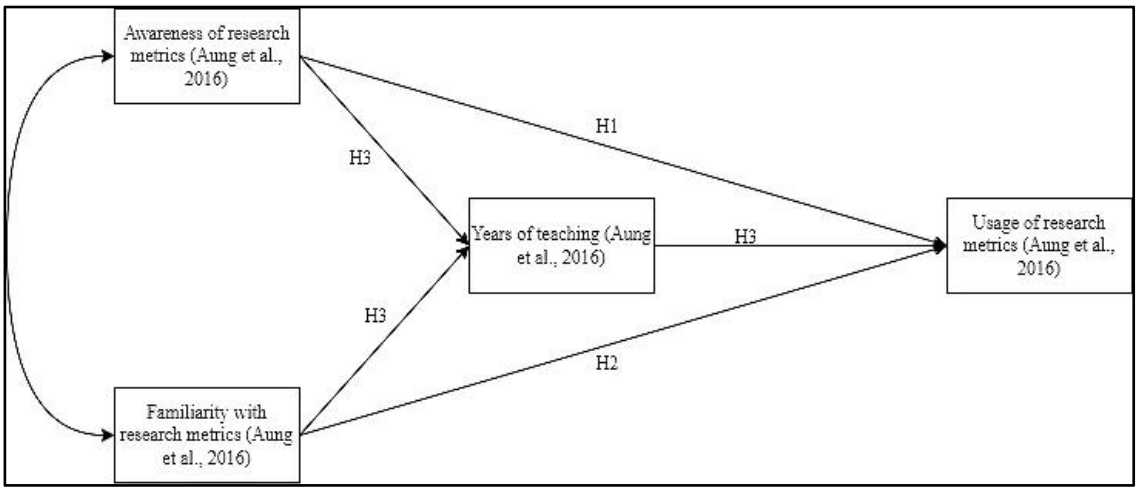

Figure 1: Research frame of this study. H: hypothesis.

METHODS

A survey questionnaire was designed based on previous studies with some modifications done (Aung, Erdt and Theng 2017; Bakker et al. 2020; DeSanto and Nichols 2017). The survey instrument consisted of six sections. A pilot study was performed with 30 academics from one private and one public university in Malaysia, to evaluate if the questionnaire was comprehensible and a minor revision was done based on the feedback received.

Section One of the survey instrument consisted of 3 questions to evaluate the awareness towards traditional metrics and altmetrics among the academics. Example of questions are; "Have you ever heard, seen or read of the following altmetrics in measuring research output" and it was adapted from the study by Aung (2016, p. 8) worldwide survey to evaluate the awareness and usage of traditional metrics and altmetrics among researchers.

Items are measured using a 5-point scale, with scores ranging from 1 (never) to 5 (always). The present study reported Cronbach's alpha, α of 0.920.

Section Two consisted of 28 items modified from Bakker et al. (2020) measuring the participants' familiarity towards traditional metrics and altmetrics among academics. The example questions include how familiar they are with the number of bookmarks, Wikipedia mentions, and number of followers of the researchers etc (Bakker et al. 2020, p.907). Items are measured using a 5-point scale, with scores ranging from 1 (not at all familiar) to 5 (extremely familiar). The present study reported Cronbach's alpha, α of 0.938.

Section Three taken from Aung (2016), we assessed the usage of research metrics among academics and the items are measured using a 5-point scale, with scores ranging from 1 (never) to 5 (always). Example of item includes "How frequent do you apply the following altmetrics" or "How frequent do you apply the following scholarly metrics?" (Aung 2016, p. 8). The present study with 27 items reported Cronbach's alpha, α of 0.717.

The fourth section consisted of 3 questions on the limitations of not using certain metrics (Aung 2016) and one of the questions is: "Despite the research metrics that you are aware of, what are your rationale(s) for not applying them?" (Aung 2016, p. 11), and 6 options are provided for selection. The fifth section concerned about the opinions of academics on traditional metrics and altmetrics and the 4 items, modified from DeSanto and Nichols (2017), are measured using a 5-point scale, with scores ranging from 1 (not agree at all) to 5 (extremely agree). Lastly, the sixth section was on the strategies used to promote research work among academics (Lemke et al. 2019) with a "Yes" and "No" option. The example question is "I always write a summary of my work to attract more audience" (Lemke et al. 2019, p. 7) and a list of challenges were provided for selection.

Demographic questions were included at the end of the instrument. Only closed ended questions were incorporated, which approximately took 15 minutes to complete. To attract attention and encourage responses, an infographic poster was attached in e-mails. After the institutional approval (UM.TNC2/UMREC_1169) was obtained, this study was disseminated via Google Form and first displayed the information section describing the purpose of the study, risks involved in this study, and the voluntary nature of involvement. It was circulated via several faculties in the universities of the affiliated authors through the Dean's office from March 2021 to May 2021. Participants were required to give their consent before answering the survey and they could withdraw without any penalty.

Partial Least Square-Structural Equation Modelling (PLS-SEM) was used and Smart PLS 3.0 was utilized to verify the correlation between the measured construct and usage of research metrics among the respondents. The measurement and structural model, as well as bootstrapping method were performed to determine the significance of the path coefficients and factor loadings of the constructs (Hair et al. 2014). Differences between healthcare and non-healthcare academics who served as the respondents of the study were also compared using Multi-Group Analysis.

RESULTS

Demographic Characteristics

Of the 344 participants, majority are female (56.4%). Meanwhile, more than half of the respondents are of the Malay population (52.3%), followed by Chinese (35.2%), Indian

(7.0%), and a minority (5.5%) from other ethnicity such as the Iban and Arab. Most of the respondents (84.0%) are from the public university, with a total of 41.30 percent of respondents are from the healthcare discipline. Almost half (49.4%) of the overall respondent hold the position of an Assistant Professor or Senior Lecturer and about one third of respondents (32.3%) have less than 5 years of experience in academia (Table 1).

Table 1: Participants' Demographic (N=344)

Demographic	Characteristics of Sample	Number (Percentage)
Gender	Male	150 (43.6%)
	Female	194 (56.4%)
Age	26-35	76 (22.1%)
	36-45	161 (46.8%)
	46-55	87 (25.3%)
	56-65	20 (5.8%)
Ethnicity	Malay	180 (52.3%)
	Chinese	121 (35.2%)
	Indian	24 (7.0%)
	Others	19 (5.5%)
Working university	Public university	289 (84.0%)
	Private university	55 (16.0%)
Academic discipline	Healthcare	142 (41.3%)
	Non-healthcare	202 (58.7%)
Academic ranking	Lecturer	81 (23.5%)
	Assistant Professor/ Senior Lecturer	170 (49.4%)
	Associate Professor	55 (16.0%)
	Professor	24 (7.0%)
	Others	14 (4.1%)
Years of teaching	Less than 5 years	111 (32.3%)
	6-10 years	92 (26.7%)
	11-15 years	60 (17.4%)
	16 years and above	81 (23.6%)

Academics' Usage of Social Media

Among the 12 social media and media sharing platforms listed in the survey (Facebook, Instagram, Twitter, YouTube, Pinterest, Google+, LinkedIn, Wikipedia, Mendeley, Almetric.com, PLOS, and Weibo), Facebook is the most widely used social media platform with 92.5 percent of the respondents having an account on Facebook, followed by LinkedIn (72%), and Instagram (63%). In contrast, almost all participants do not own any account on Altmetric.com (97.1%), Weibo (94.5%), and Wikipedia (93.6%).

Academics' Awareness, Familiarity and Usage of Altmetrics

The respondents are mostly not aware of altmetrics with only 4.9 percent reported that they always investigate the scoring method of altmetrics; 7.0 percent always use altmetrics to measure research outputs, and 16.0 percent have always heard, seen or read about altmetrics (Table 2).

The respondents are most familiar with the number of likes and shares on Facebook with 16.6 percent reported extremely familiar with it, followed by YouTube (14.5%), and Twitter (14.0%). In contrast, number of bookmarks is the least familiar altmetrics measures among respondents (2.9%) (Table 2).

Table 2: Awareness, Familiarity, and Usage of Altmetrics among the Malaysian Academics

Awareness of altmetrics	**Number (Percentage)**				
	Never	**Seldom**	**Sometimes**	**Often**	**Always**
Have you ever looked into the scoring method of altmetrics?	181 (52.6%)	58 (16.9%)	46 (13.4%)	42 (12.2%)	17 (4.9%)
Have you ever used altmetrics to measure research outputs?	185 (53.8%)	49 (14.2%)	39 (11.3%)	47 (13.7%)	24 (7.0%)
Have you ever heard, seen, or read about altmetrics?	142 (41.3%)	39 (11.3%)	38 (11.0%)	70 (20.4%)	55 (16.0%)
Familiarity of altmetrics	**Number (Percentage)**				
	Not at all familiar	**Marginally familiar**	**Somewhat familiar**	**Familiar**	**Extremely familiar**
Number of bookmarks	133 (38.6%)	67 (19.5%)	62 (18.0%)	72 (21.0%)	10 (2.9%)
Wikipedia mentions	113 (32.8%)	78 (22.7%)	68 (19.8%)	69 (20.1%)	16 (4.6%)
Number of followers of the researchers	70 (20.4%)	62 (18.0%)	85 (24.7%)	100 (29.1%)	27 (7.8%)
Number of likes and shares on LinkedIn	69 (20.0%)	37 (10.8%)	79 (23.0%)	114 (33.1%)	45 (13.1%)
Number of likes and shares on Twitter	71 (20.6%)	47 (13.7%)	60 (17.4%)	118 (34.3%)	48 (14.0%)
Number of likes and shares on YouTube	70 (20.4%)	51 (14.8%)	66 (19.2%)	107 (31.1%)	50 (14.5%)
Number of likes and shares on Facebook	61 (17.7%)	47 (13.6%)	57 (16.6%)	122 (35.5%)	57 (16.6%)
Usage of altmetrics	**Number (Percentage)**				
	Never	**Seldom**	**Sometimes**	**Often**	**Always**
Wikipedia mentions	215 (62.5%)	85 (24.7%)	26 (7.5%)	13 (3.8%)	5 (1.5%)
Number of bookmarks	179 (52.0%)	63 (18.3%)	59 (17.2%)	32 (9.3%)	11 (3.2%)
Number of likes and shares on YouTube	173 (50.3%)	83 (24.1%)	50 (14.5%)	26 (7.6%)	12 (3.5%)
Number of likes and shares on Twitter	170 (49.4%)	67 (19.5%)	48 (14.0%)	41 (11.9%)	18 (5.2%)
Number of followers of the researchers	139 (40.4%)	71 (20.6%)	70 (20.4%)	45 (13.1%)	19 (5.5%)
Number of likes and shares on Facebook	150 (43.6%)	65 (18.9%)	58 (16.8%)	46 (13.4%)	25 (7.3%)
Number of likes and shares on LinkedIn	149 (43.3%)	54 (15.%)	56 (16.3%)	60 (17.4%)	25 (7.3%)

Hindrances and Concerns in Using Research Metrics and Altmetrics

We investigated the possible obstacles faced by the academics in Malaysia when it comes to the usage of research metrics and altmetrics. From the analysis, lack of skills (48.3%) appears to be the most self-reported hindrance to not using research metrics, followed by

the lack of time (44.8%). Surprisingly, 14.2 percent of the respondents reported that they regard research metrics as non-beneficial to them. Meanwhile, 13.6 percent of them confessed that knowing and using research metrics do not have any impact on them. Figure 2 illustrates the results.

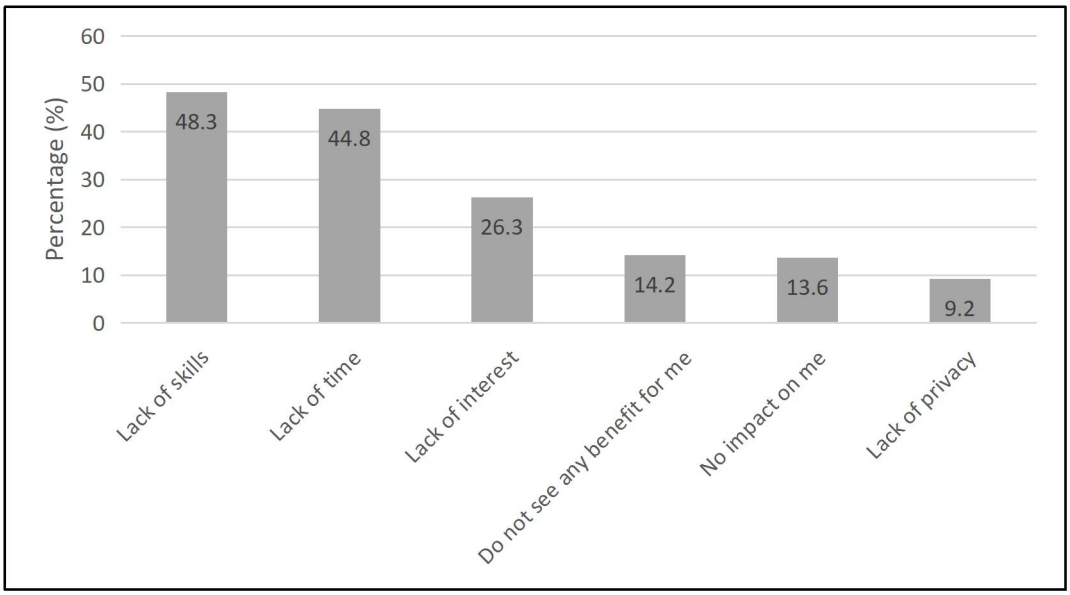

Figure 2: Hindrances to Not Using Research Metrics among the Malaysian Academics

The concerns raised when using research metrics, especially the altmetrics which largely employ the use of social media**,** are amongst other, information overload/spamming (41.7%), separation of private and professional matters/privacy (41.2%), and time consumption (39.4%). A total of 39.1 percent of the respondents are concerned about the "data security" when it comes to the usage of almetrics. Figure 3 presents the findings.

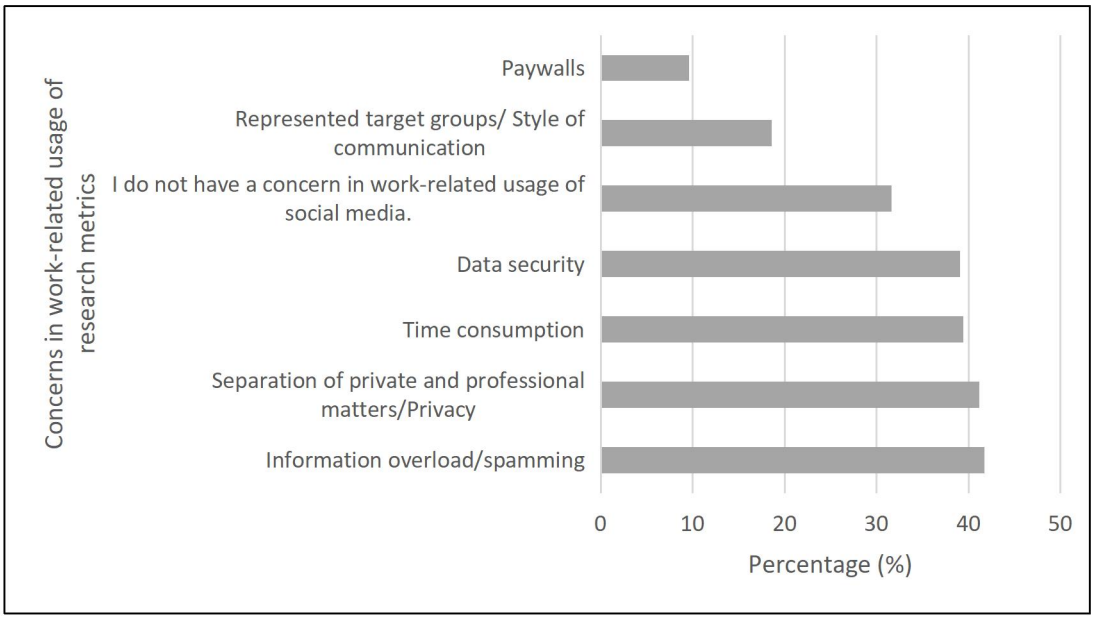

Figure 3: Concerns in Work-related Usage of Research Metrics, Including Altmetrics.

Measurement Model Assessment

Factor loadings, average variance extracted (AVE), and composite reliability (CR) were extracted to assess the convergence validity. Convergent validity is achieved only when all items in a measurement model are statistically significant (Ahmad, Zulkurnain and Khairushalimi 2016). A total of 19 items which reported low factor loading of lower than 0.50 were removed, where 11 items were from the section "familiarity of research metrics" (F12, F17, F18, F4, F1, F3, F9, F2, F13, F19, and F20) and 8 were from the section "usage of research metrics'' (U8, U11, U10, U24, U28, U9, U19, and U16). The remaining items reported factor loading between 0.517 to 1.000. Besides the 19 items, other items surpassed the recommended value of 0.5, which is the accepted level as suggested by Hair et al. (2019), leaving a total of 41 items in the measurement model.

The CR values were ranged from 0.945 to 1.000 which exceeded the recommended value of 0.7 (Alarcón, Sánchez and De Olavide 2015). The AVE were in the range of 0.503 and 1.000, all of which were greater than the recommended value of 0.50 (Ahmad, Zulkurnain and Khairushalimi 2016). With the factor loading, AVE and CR reported, we could conclude that convergent validity is met in this study. Besides, to ensure the reliability of the questionnaire, Cronbach Alpha was tested based on Adeyemi (2021). The Cronbach's alpha ranged between 0.717 and 1.000 which is higher than 0.7, hence, the questionnaire demonstrated strong reliability among the constructs (Hair et al. 2014). The summarized results are shown in Table 3.

Discriminant validity was assessed with heterotrait-monotrait (HTMT) ratio. There is a lack of discriminant validity if the value of the HTMT is higher than the threshold of 0.85 (Alarcón, Sánchez and De Olavide, 2015), the results are reported as less than 0.85. Besides, the HTMT Bootstrap analysis found that all relationships have a confidence interval value of lower than 1 (e.g., the relationship between the familiarity of research metrics and awareness of research metrics: CI = [0.487, 0.608]), which demonstrate that all construct measures different context. This shows that discriminant validity in all constructs is established. In addition, common method variance (CMV) was evaluated by comparing the R-square with CMV to the original R-square, which gives 0% difference, thus, demonstrating the dataset has no issue with CMV.

Structural Model Assessment

The predictor namely familiarity towards research metrics is important and predicted the usage of research metrics among academics in Malaysia, which explained 62.7% variance on usage of research metrics (Figure 4). Findings showed that familiarity of research metrics was the only predictor to the usage of research metrics among academics in Malaysia (ß= 0.776, p<.01), thus, H2 is supported but not H1. There was also no significant mediator effects of academic seniority and awareness, familiarity, and usage of research metrics, thus H3 was not supported (Table 4).

Partial Least Squares Multi-Group Analysis (PLS-MGA)

Partial Least Squares Multi-Group Analysis (PLS-MGA) was conducted to analyze if there is any difference of results between healthcare and non-healthcare academics. All hypotheses were rejected as all relationships hypothesized are statistically not significant (p>.05). The MGA analysis further confirmed that there is no significant difference in usage of research metrics between healthcare and non-healthcare academics (Table 5).

Table 3: Reliability and Convergent Validity of the Measurement Model

Construct	Item	Loadings	AVE	CR	Cronbach Alpha
Awareness on Research Metrics	A1	0.898	0.872	0.953	0.927
	A2	0.950			
	A3	0.953			
Familiarity of Research Metrics	F5	0.655	0.503	0.945	0.938
	F6	0.803			
	F7	0.798			
	F8	0.808			
	F10	0.786			
	F11	0.784			
	F14	0.640			
	F15	0.794			
	F16	0.805			
	F21	0.684			
	F22	0.678			
	F23	0.625			
	F24	0.629			
	F25	0.600			
	F26	0.628			
	F27	0.631			
	F28	0.640			
Usage of Research Metrics	U1	0.517	0.944	0.951	0.717
	U2	0.596			
	U3	0.549			
	U4	0.582			
	U5	0.547			
	U6	0.567			
	U7	0.611			
	U12	0.801			
	U13	0.824			
	U14	0.828			
	U15	0.870			
	U17	0.882			
	U18	0.833			
	U20	0.575			
	U21	0.763			
	U22	0.864			
	U23	0.875			
	U25	0.532			
	U26	0.596			
	U27	0.684			
Years of Teaching	Years of Teaching	1.000	1.000	1.000	1.000

Note - AVE: average variance extracted; CR: composite reliability

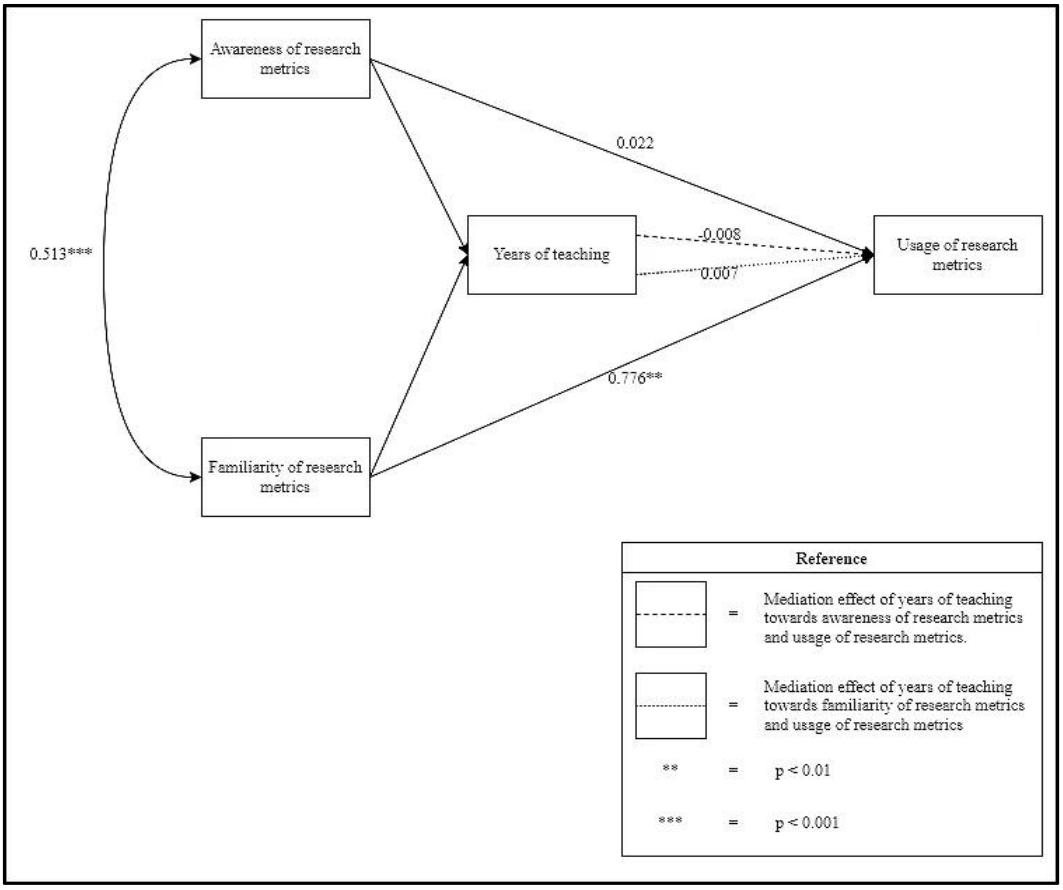

Figure 4: Structural Model Assessment on the Usage of Research Metrics Among Academics in Malaysia

DISCUSSION

This study was put forward to examine the relationship of awareness, familiarity, and usage of traditional research metrics and altmetrics among academics in Malaysia. From the findings, familiarity is the only key factor affecting the usage of research metrics among academics. It indicated that academics commonly use the metrics that they are familiar with as compared to the unfamiliar one. This is aligned with the review by Aung et al. (2019) on the familiarity and usage of research metrics among scholars where the more familiar a metric is, the more it is used. Academics may be more comfortable and proficient with those that they are familiar with, hence they may not use the unfamiliar metrics even though they are aware of them. However, academic seniority (i.e., years of teaching) does not affect the usage of research metrics among academics as they may not be experienced in utilizing research metrics even with many years of teaching experience. Also, there is no significance difference between the healthcare and non-healthcare academics in the usage of research metrics.

In addition, academics with lesser years of teaching are more aware of research metrics. However, unsurprisingly, familiarity towards traditional research metrics is higher among senior academics. This could be explained where senior academics are more experienced and skilled in evaluation of publications and their use in academic promotion and tenure. Academics with lesser years of teaching are aware of various metrics available but may not be familiar in utilization of research metrics since they just join the universities for a few years.

Table 4: Direct Relationships between Factors

Hypothesis	Std Beta	Std Error	t-value	Decision	f^2	q^2	95%CI LL	95%CI UL
Awareness of Research Metrics -> Usage of Research Metrics	0.022	0.041	0.532	Not Supported	0.001	0.000	-0.055	0.102
Familiarity of Research Metrics -> Usage of Research Metrics	0.776	0.030	25.74**	Supported	1.160	0.307	0.717	0.834
Mediated Relationships with seniority as the mediator								
Familiarity of Research Metrics -> Years of Teaching -> Usage of Research Metrics	0.007	0.008	0.908	Not Supported			-0.005	0.026
Awareness of Research Metrics -> Years of Teaching -> Usage of Research Metrics	-0.008	0.008	0.968	Not Supported			-0.025	0.006

Note. *p<0.05; **p<0.01

Table 5. Partial Least Squares Multi-Group Analysis (PLS-MGA): Hypothesis (Healthcare vs Non-healthcare)

Hypothesis	Path Coefficients-diff (Healthcare vs non-healthcare)	p-Value new (Healthcare vs non-healthcare)	Decision
Awareness of Research Metrics -> Usage of Research Metrics	0.042	0.635	Not Supported
Awareness of Research Metrics -> Years of Teaching	-0.148	0.277	Not Supported
Familiarity of Research Metrics -> Usage of Research Metrics	-0.001	0.983	Not Supported
Familiarity of Research Metrics -> Years of Teaching	-0.005	0.972	Not Supported
Years of Teaching -> Usage of Research Metrics	-0.035	0.62	Not Supported

The study reveals that there is no significant relationship between the awareness and usage of altmetrics. This could be due to academics in Malaysia have low awareness on altmetrics and the fact that these academics are newly exposed to altmetrics in recent years. In a way, altmetrics are still new and do not have the established credibility as compared to the traditional metrics which are well established. Traditional metrics are commonly used and standardized to be one of the evaluation criteria in promotion and tenure in Malaysia, whereas altmetrics are not emphasized yet. The outcomes corroborate with the results from Adeyemi (2021) where more than half of their respondents reported that they have no knowledge in measuring research impact using altmetrics and in how altmetrics measure citation.

From the findings, most academics are not familiar with altmetrics as compared to traditional metrics based on citations. This may be explained where most universities have not completely acquainted with altmetrics and hence altmetrics are not greatly encouraged and promoted among academics. The findings are consistent with the result presented by Sutton et al. (2018) where only one third of their respondents reported to be an expert or almost expert regarding their level of familiarity with altmetrics. Further findings show that the Malaysian academics are more familiar with traditional metrics as compared to altmetrics. However, not all traditional metrics are well known among academics. For example, Source Normalized Impact per Paper (SNIP) and Eigenfactor score are not familiar among the respondents even though these citation-based metrics are among the well-established traditional metrics. The common traditional metrics being emphasized in promotion and tenure are the total number of citations, JIF, and H-index (Carpenter, Cone and Sarli 2014). Hence, unsurprisingly, they ranked top 3 from the list of traditional metrics. The study by Aung et al. (2019) was on track with the current study, where their participants were most familiar with JIF, the total number of citations, and H-index while other traditional metrics such as the SNIP was not familiar to their respondents. Traditional metrics have been widely adopted for many years for information searching, self-assessment, appraising of others' work, and for academic promotion and tenure process.

Majority of the academics may still on hold with the rigid mentality where scholarly outputs and professional matters can only be reached through academic social-networking sites such as LinkedIn and ResearchGate. Consistent with this study, Sugimoto et al. (2017) proved that almost a quarter of participants used LinkedIn for professional purposes. From this study's results, lack of skills is the major concern which may correlate with the familiarity and awareness of traditional metrics and altmetrics among academics. Academics opt for traditional metrics as they are more familiar with them. Altmetrics are still new to them, and they may not be proficient to employ altmetrics for professional purpose. Hence, altmetrics are used at a lesser extent as compared to traditional metrics due to the lack of skills in academics. Also, lack of time is the second major hindrance being reported by the respondents. This is not surprising, as academics are always occupied with duties including preparation of lecture materials, attending staff meetings, conferences, and seminars, conducting research, and developing curriculum, therefore they may not have sufficient time to experiment with new tools such as altmetrics. Academics are constantly occupied with jobs, hence the overloading information on social media may trouble them, causing it to be the major concern reported. The emergence of online social networking has led to a dramatic surge in the amount of information exposed to users, significantly increasing the chances of information overload, which

may be annoying. The second concern of separation of private and professional matters may be associated with the concern of time consumption. Time consumption is frequently linked to the doubt whether time spent on social media is qualified as “work” and whether it is considered “wasting time” while surfing social media during work (Lemke et al. 2019, p.7). The time spent on social media may be considered as unproductive hence academics are more inclined to separate their work from private matters to ensure they can concentrate on their work without diverting attention on private matters. Aung et al. (2019) also presented that lack of time is the greatest impediment among academics in utilizing social media as they do not have sufficient time to engage in modern technologies.

CONCLUSIONS

This study sheds light onto awareness, familiarity, usage, and factors affecting the usage of research metrics among academics in Malaysia. Most academics are not aware of altmetrics, and hence are not employing any strategy via altmetrics to promote their work. Major barriers inhibiting academics from using some recognized research metrics are lack of skills and time while the major concerns in work-related usage of social media are information overload, separation of private and professional matters, and lack of time. Finally, altmetrics should only be used to complement traditional metrics, but not replacing them as there is no single metric can provide the whole picture in evaluation of any research work. The current study is a cross sectional study where self-reported data was collected and from a single source. It is acknowledged that the results cannot represent the entire academic population worldwide. Therefore, similar with Aung et al. (2019) there is a call for future studies to cover academics from variety of academic disciplines around the world.

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AUTHOR DECLARATION

This study had been approved by Universiti Malaya Research Ethics Committee (UMREC) with the code of UM.TNC2/UMREC_1169. The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. The authors confirmed that there are no known conflicts of interest associated with this publication

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