



Can document characteristics affect motivations for literature usage?

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Abstract

Beyond citations, the impact of scientific publications is often measured by usage metrics, such as downloads, save counts and sharing counts. However, the motivations behind the utilization of these publications and their influencing factors have not yet been well studied. Therefore, it remains questionable whether and to what extent usage metrics can reflect the impact of publications. Based on expectancy-value theory, the aim of the present study was to examine the differences in behavioral characteristics and driving factors between article downloading, sharing, and saving, especially document characteristics. For the present study, survey data from 480 respondents across Chinese universities were collected and investigated in terms of the frequency and purpose of three literature usage behaviors, namely, downloading, sharing, and saving. Additionally, 11 document characteristics were used to construct three variables in the research models: intrinsic interest value, attainment value, and utility value. Their effects on three usage behaviors were examined based on path analysis via SmartPLS. The results showed that the overall frequency of article downloading and saving was greater than that of article sharing. The primary purposes of downloading and saving were closely related to scientific research, such as for review and citing. The sharing of articles on social media was mainly for agreeing with their opinions. Both intrinsic interest value and utility value exhibited a significant positive influence on article-downloading, whereas attainment value and intrinsic interest value showed a significant relationship with sharing and saving, respectively. In conclusion, different literature usage behaviors can be triggered and driven by the distinct values of research articles. The results obtained in this study could help to clarify the determinants of different usage behaviors; additionally, they might promote the reasonable application of usage metrics or altmetrics in scientific evaluation.

Keywords Downloading · Sharing · Saving · Literature usage behaviors · Document characteristics

Introduction

The use of academic literature is closely related to scientific research activities. With the advent of electronic resources, particularly electronic journals, literature usage behavior can be captured and recorded in real time. These usage data, usage metrics and altmetrics have become increasingly popular in scientometric analyses. According to Glänzel and Gorraiz (2015), usage metrics target downloads and views, whereas altmetrics comprise an abundance of very heterogeneous indicators from mentions and captures to links, bookmarks, storage, and conversations. Numerous scholars have attempted to use new metrics to identify the invisible impact of research output, which cannot be measured by traditional citation counts (Said et al., 2019; Wang et al., 2016; Yang et al., 2021; Yu et al., 2023). Many studies have confirmed that altmetrics represent an interesting complement to traditional citations based on correlation analysis between citations and altmetrics (Lemke et al., 2022; Yang et al., 2021).

Usage metrics and altmetrics have also been employed in previous studies to analyze usage patterns, reflecting the external attributes of behavioral characteristics, including spatiotemporal distributions (Eldakar, 2019; Wang et al., 2013), discipline differences (Galbraith et al., 2023), and statistical distributions (Wang et al., 2016). However, the in-depth purposes and intrinsic motivations of literature usage are difficult to describe by usage indicators, especially at the individual level. Furthermore, there is a certain dispute about the reliability of usage indicators in academia, especially regarding the reasonable use of relevant indicators for the valuation of research.

Recently, some scholars have focused on the motivations behind some literature usage behaviors, such as Mendeley bookmarks (Mohammadi et al., 2016), tweet authors' citations (Na, 2015), self-archiving (Lee et al., 2019), article sharing (Kim & Sir Oh, 2020), and downloading (Xiong et al., 2023). However, the aforementioned studies focused exclusively on a single type of literature usage behavior. Little research has been conducted to simultaneously investigate the usage behaviors of multiple studies and compare their diverse motivations or influencing factors. To address this issue, the frequency, purpose, and relationships of three types of literature usage behaviors among Chinese university members, namely, downloading, sharing, and saving, were investigated in the present study using document characteristics. In this study, article-downloading was defined as the process of receiving the full texts of research articles on the internet, including PDF, EPUB, CAJ, and other formats. Article sharing is the process in which users transmit full text, bibliographical information, or related web links to others through various online social networks (OSNs), such as Twitter, Facebook, WeChat, blogs, and SNSs. The term “article saving” refers mainly to the process of saving bibliography information or full text in reference management software (RMS) (e.g., Mendeley or EndNote) or in network bookmarks. The objective of this study was to identify the differences in behavioral characteristics and driving factors, especially document characteristics, among articles downloading, sharing, and saving. The following research questions were formulated:

- RQ1: What was the overall characteristic difference between article downloading, sharing, and saving (e.g., frequency)?
- RQ2: What document characteristics drove users to download, share, or save research articles?

Literature review

Literature usage behavior

The usage behavior for scholarly articles was complex and diverse throughout the whole scientific research and knowledge flow process. Generally, a researcher might engage in one or more types of behaviors, such as searching, reading, downloading, sharing, saving, or citing. In the printed past, information scientists' and librarians' main attention was given to citation data, print reshelving data, and circulation data to determine the value of a journal in a field of study or a library collection (Duy & Vaughan, 2006). With the emergence of electronic journals, the usage behaviors of scholarly articles were meticulously tracked and recorded with the assistance of digital publishers and information integration platforms (e.g., Web of Science). On this basis, usage metrics and altmetrics, which can reveal various types of usage behaviors represented by objective and normative data, have emerged and are widely utilized in the field of information science. In the narrow sense, usage metrics represent downloads and views, while altmetrics refer to the repercussions of whatsoever publications on the web, notably on social media (Glänzel & Gorraiz, 2015). In this paper, these indicators are described as literature usage indicators.

Numerous studies have analyzed the statistical patterns of literature usage indicators to elucidate the behavioral characteristics and usage preferences of users. Wang et al. (2013) explored scientists' working habits by analyzing real-time downloaded data from the scientific literature. Chen (2018) compared differences and similarities between WoS usage counts and Springer usage counts by combining statistics, correlation analysis, the Jaccard similarity coefficient and overlay mapping. The results revealed that WoS and Springer shared broad user interests at the indicator level, and WoS and Springer also had their own unique user interests at the author level and content level. Khan and Younas (2017) investigated the download behavior of readers for two well-known IEEE journals in the field of education by using download data.

Additionally, literature usage indicators are frequently discussed in association with traditional citation metrics; their correlations were used to validate the appropriateness and value of usage indicators for research evaluation. Previous studies have shown that some altmetrics have low or moderate correlations with citations (de Winter, 2015; Haustein et al., 2014; Mohammadi & Thelwall, 2014). The relationships varied across different disciplines, journals, and literature databases (Chi & Glänzel, 2018). Overall, the emergence of literature usage indicators has provided a new research perspective for characterizing literature usage behaviors. However, some limitations were also found in these studies that adopted usage indicators. On the one hand, in-depth motivations cannot be determined by these usage indicators. On the other hand, many usage indicators might not provide a complete picture of usage behaviors. For example, more than 91% of altmetrics mentions stemmed from Twitter (Said et al., 2019). However, Twitter was not the most widely used online social network for information sharing and content dissemination in China.

Triggering factors of usage behavior

In terms of the factors triggering and driving literature usage behaviors, some researchers have employed psychology and behavioral theory to study motivators. Xiong et al. (2023) proposed an expanded technology acceptance model (TAM) to investigate motivations for

downloading academic literature and reported that perceived usefulness and perceived relevance were the primary factors that drive users to download specific literature. Kim and Sir Oh (2020) employed a theoretical framework that integrated the theory of planned behavior, community considerations, and reciprocity to examine social and individual motivation factors affecting researchers' article-sharing intentions through the use of institutional repositories or ResearchGate. Lee et al. (2019) developed a model composed of 18 factors to investigate motivations for self-archiving research items on academic social networking sites. Some scholars have also conducted content analysis or questionnaire surveys to summarize and classify the categories of user motivations (Mohammadi et al., 2016; Na, 2015).

Apart from intrinsic motivations, many studies have examined the effects of the document characteristics (titles, journals, authors, publication time, etc.) of scholarly articles on usage behavior, particularly citations. Pearson (2021) explored usage patterns of quoted speech in linguistics research article titles and their effects on citations. The regression analysis showed that speech act titles were significant negative determinants of articles' age-weighted citations, particularly the prevalent pattern of compound structures featuring a quotation phrased as a declarative. Hu et al. (2021) analyzed the writing style of abstracts of highly cited papers from four aspects: vocabulary, sentence, syntax and readability. Fiala et al. (2021) verified the hypothesis that computer science papers asking questions (i.e., those with a question mark at the end of their title) were cited more frequently than those that did not have this property. Some scholars have focused on the relationships between document characteristics and downloads or social media mentions. Chen et al. (2020) explored the linguistic characteristics (e.g., title length and average sentence length) of highly browsed and downloaded academic articles. Haustein et al. (2015) found that both citations and social media metrics increase with the extent of collaboration and the length of the reference list. Wang et al. (2016) found that the publication time and number of citations of papers could affect researchers' usage preferences. Jamali and Nikzad (2011) investigated the impact of the type of article title (including descriptive, indicative and question) on the number of citations and downloads articles received and found that articles with question titles tended to be downloaded more but cited less than others. Since previous research has provided valuable evidence that document characteristics can affect literature usage behaviors, little is known about the differences in the factors influencing different types of usage behaviors. In other words, the same document characteristics might have different effects on downloading, sharing, or saving.

Theoretical foundation and research model

Eccles and Wigfield's (2002) expectancy-value theory (EVT) was utilized as the main theoretical foundation in this study. EVT assumes that the expectancy of success is shaped by motivational beliefs that fall into three broad categories: task, self-concept and subjective task values (Eccles & Wigfield, 2002). Individuals choose those studies they believe they can master and that are of value to them. That is, values and self-ability beliefs are the most important predictors of academic choices and behaviors (Sáinz et al., 2018). Task refers to specific short- and long-term objectives of behavior; it was identified as literature usage behavior in this paper, including downloading, sharing and saving. Self-ability beliefs are defined as individuals' evaluations of their competence in different areas (Eccles & Wigfield, 2002). Specifically, self-ability beliefs are a psychological determinant that indicates the conviction that one

can successfully execute the required behavior, for example, to be able to download, share, or save papers. Finally, subjective task value consists of the following components: intrinsic interest value (or intrinsic enjoyment value, attainment value, utility value, and relative cost) (Reijo, 2012). The first three values are positive task characteristics, whereas the last one is a negative task characteristic. In this context, relative cost is conceptualized in terms of the negative aspects of the usage behavior of research articles, such as the effort of accessing articles; in other words, it is identified as the degree to which one believes that downloading, sharing, or saving a specific publication is free of effort. In some studies, relative cost was also named ease of use and is often related to the literature databases or tools (Xiong et al., 2023). Therefore, relative cost and self-ability beliefs do not belong to the category of documentary characteristics. One of the main research objectives in this study is to explore the different effects of document characteristics on literature usage behaviors. Hence, relative cost and self-concept were ignored in this study. EVT has been frequently employed to examine motivations for seeking information (Reijo, 2012; Savolainen, 2013; Sigaard & Skov, 2015). Generally, the usage behaviors of research articles, including downloading, sharing and saving, are all information behaviors.

Intrinsic interest value

The intrinsic interest value refers to the interest and enjoyment that individuals gain from using a research article (Eccles & Wigfield, 2002; Reijo, 2012). An example that illustrates the intrinsic interest value is a user who uses a research article because she or he has an interest in this article (Eccles, 2009). Perceived interest or enjoyment is usually influenced by the title or topic of an article (Heard et al., 2023; Subotic & Mukherjee, 2013). In this study, the intrinsic interest value was constructed by three document characteristics: `hot_topic`, `consistent_field`, and `interest_title`. Detailed descriptions of these characteristics are shown in Online Appendix B.

Attainment value

Attainment value is defined as the value attached to a task that is congruent with personal and collective identities (Eccles, 2009). According to prior studies on researchers' reflections on the values of their research experience (Ceyhan & Tillotson, 2020), attainment value is related to the alignment of research with their sense of self, the personal importance of engaging in research, or the contribution of research to their science identity. In this context, attainment value was extended to the importance of a research article to users or how well literature usage fits with individuals' identity, consisting of the following document characteristics: `early_publish`, `by_share`, `certain_author`, and `certain_institution` (Online Appendix B). Generally, individuals may prefer to use papers for which authors or institutions are relevant to themselves. This positive effect is often found in citation relationships (Case & Higgins, 2000), and could improve interpersonal connections with other authors or enhance self-identity in the academic community (i.e., institutions) (Xiong et al., 2023).

Utility value

Utility value is determined by how well using a research article relates to current and future goals, such as academic publishing (Eccles, 2009; Eccles & Wigfield, 2002).

Such a research article can have positive value to a person because it facilitates important future goals, even if he or she is not interested in the research article for its own sake (Reijo, 2012). In a previous study, utility value was also sometimes called usefulness (Xiong et al., 2023). Utility value covered four document characteristics: high_journal, high_citation, high_download, and new_publish (Online Appendix B). As stated above, this study includes three research models, as shown in Fig. 1, which show that three types of value (intrinsic interest value, attainment value, and utility value) positively affect downloading, sharing, and saving.

Methodology

Survey questionnaire

A survey questionnaire was developed using Wenjuanxing (<https://www.wjx.cn/>) and consisted of four parts: (I) participants' background information, (II) article-downloading behavior, (III) article-sharing behavior, and (IV) article-saving behavior. The background questions asked about a participant's occupation, age, publishing experience, and study discipline. The questions related to downloading, sharing, and saving all covered behavioral frequency, behavioral purposes, and the effects of document characteristics. The respondents were asked to rate 11 statements describing document characteristics ranging from 1 (strongly disagree) to 5 (strongly agree). These statements were categorized into three types of value—intrinsic interest value, attainment value, and utility value—the three constructs of the model (Fig. 1). This study employed partial least squares (PLS) path modeling techniques to investigate the effects of document characteristics on three literature usage behaviors. The software package SmartPLS was used to perform both instrument validation and structural path modeling. Before the formal survey, we conducted a pilot test by employing a convenience sample of 30 researchers from Chinese universities. According to the feedback, the instrument was refined, and the final questionnaire is available in Online Appendix A.

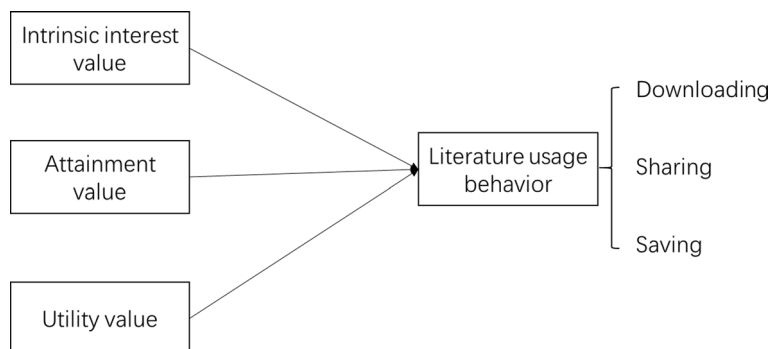


Fig. 1 Research model of literature usage behavior

Data collection

The survey data were gathered from 1025 members of Chinese universities and research institutions via a survey questionnaire disseminated on social media platforms (e.g., WeChat or QQ) from 2021/3/2 to 2021/3/15. To compare behavioral characteristics and usage motivations among different types of users, this survey was extended to a wider range of users, including faculty (i.e., lecturers, associate professors, professors), undergraduate students, graduate students (including Ph.D. students and master students), supporting staff (e.g., librarians, technical support staff) and others (e.g., administrative staff). Participation in the investigation was voluntary, and participants could opt out at any time. All replies were processed with the utmost confidentiality. The survey response rate was approximately 51.22%, with a total of 525 respondents who completed the survey questions by the end of the survey. Forty-five replies were deleted due to inordinately short response times (less than 5 min) or repeated answers for all questions. Hence, the overall valid response rate was 46.83%, with a total of 480 valid responses.

Table 1 displays the demographic information of the respondents. Over half of the survey respondents were graduate students (34.58%) or undergraduate students (32.08%), and the rest were faculty (16.67%), support staff (6.04%), or others (10.63%). Approximately 88.75% of respondents were younger than 40 years old. The disciplines of the respondents were mainly STEM (science, technology, engineering, and mathematics) (51.67%), followed by HSS (humanities and social science) (38.33%). In terms of publishing experience, less than half of the respondents had published as their first or corresponding author (42.71%) or another type of coauthor (5.21%). The remaining 39.17% had never written academic articles, and 12.92% of respondents were writing and preparing to publish.

Table 1 Respondents' demographic attributes

Characteristic	Category	Number	Percentage
Occupation	Faculty	80	16.67%
	Undergraduate student	154	32.08%
	Graduate student	166	34.58%
	Supporting staff	29	6.04%
	Others	51	10.63%
Age	≤ 30 years old	321	66.88%
	31–40 years old	105	21.88%
	41–50 years old	47	9.79%
	> 50 years old	7	1.46%
Publishing experience	Published as the first or corresponding author	205	42.71%
	Published as other co-author	25	5.21%
	Writing and preparing to publish	62	12.92%
	Never write	188	39.17%
Study discipline	Humanities and social science	184	38.33%
	Science, Technology, Engineering, and Mathematics	248	51.67%
	Agricultural science	30	6.25%
	Medical Science	3	0.63%
	Others	15	3.13%

Results

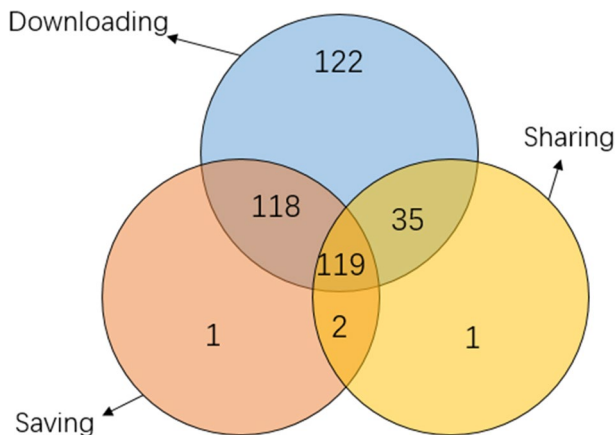
Sample analysis

Of the 480 valid respondents, 466 had downloaded scholarly articles, 229 had shared literature on OSNs, 312 had saved literature in the RMS, and 10 had never downloaded, shared or saved. There were 122 respondents who had downloaded but had not shared or saved (Fig. 2). These respondents mostly consisted of undergraduate students (60, 49.18%). Approximately 57.38% of the respondents had never published scholarly publications. The respondents whose data were downloaded were mainly for the purposes of literature review and citation. There was 1 respondent who only shared but did not download or save. This respondent was an undergraduate student and shared articles on OSNs mainly for agreeing with the opinions of the articles. A similar situation was also found in the subset where the respondents only saved but did not download or share. This subset contained only 1 respondent who was an undergraduate student, and the purpose of saving was mainly for citing. There were 191 respondents within the subset who exhibited all three usage behaviors simultaneously. In this part, graduate students accounted for the highest proportion (70, 36.7%). Additionally, more than half of the respondents had published as their first or corresponding author (55.5%). Their purposes of downloading, sharing and saving were similar to those of the total sample ($N=480$).

Behavioral frequency

Approximately 34.17% ($n=164$) of respondents downloaded scholarly articles at least once a week, followed by at least once a month (23.54%, $n=113$), every day (17.29%, $n=83$), at least once each half year (14.38%, $n=69$), and at least once a year (7.71%, $n=37$). The frequency distribution of article sharing was approximately contrary to that of article downloading. Most respondents had shared on OSNs at least once a year (18.33%, $n=88$) or at least once each half year (15.83%, $n=76$). A low proportion of respondents were presented with higher frequencies of article-sharing behavior, at least once a month (10.00%, $n=48$), at least once a week (2.71%, $n=13$), and every day (0.83%, $n=4$). Among the respondents who had saved scholarly articles in the RMS, a relatively balanced population

Fig. 2 Sample distribution of article-downloading, article-sharing, and article-saving



distribution could be found in different frequencies of article savings. The saving frequency for 15.42% ($n=74$) of the participants was at least once each half year, followed by at least once a month (14.58%, $n=70$), at least once a year (14.38%, $n=69$), at least once a week (12.29%, $n=59$), and every day (8.33%, $n=40$). Among the respondents who frequently downloaded, shared, and saved academic articles (every day), 65.06%, 75.00%, and 52.50%, respectively, were graduate students. With respect to publication experience, the proportions of respondents who published as the first or corresponding author were 71.08% (downloading every day), 75.00% (sharing every day) and 75.00% (saving every day). As shown in Fig. 3, the respondents who had never downloaded scholarly articles mostly never saved or shared them. Some respondents with high-frequency downloading showed low-frequency savings or sharing. Generally, there were distinct frequencies of article downloading, article sharing, and article saving for the same respondent.

Behavioral purposes

The purposes of downloading, sharing, and saving research articles were surveyed in this study. Approximately 89.27% of the respondents downloaded research articles for the purpose of a literature review (Fig. 4). A total of 66.31% of the respondents downloaded research articles to cite them in academic writing. There was little difference between the proportions for the purposes of personal interest(non-academic) and teaching, (36.48% and 35.19%, respectively). As indicated by the average scores of different occupations (Table S1 in Online Appendix C), faculty members downloaded academic articles for teaching materials due to their teaching tasks. Furthermore, supporting staff might have less research pressure and more time to read, so they were more likely to download literature according to their personal interests compared to other occupations.

In terms of article sharing (Fig. 5), the majority of respondents (81.22%) reported that they shared academic articles on OSNs to agree with the opinions of the articles. Second, 71.62% of respondents shared research articles with others on OSNs to increase their understanding of the literature. Approximately 55.90% of respondents who shared articles used OSNs as a storage tool because of the convenience of searching or reading them later. However, only 41.92%, 37.56%, and 22.27% shared articles on OSNs for triggering discussion, showing their own understanding, or disagreeing with the opinions of the articles, respectively. There were some small differences in the average scores of different

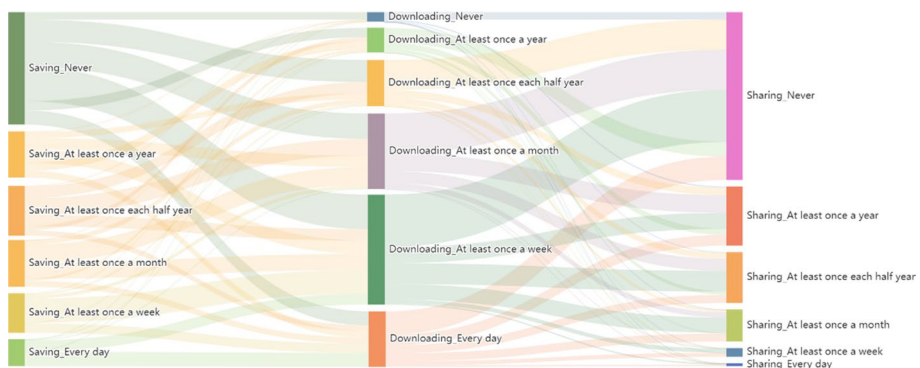


Fig. 3 The frequency of article downloading, article sharing, and article saving

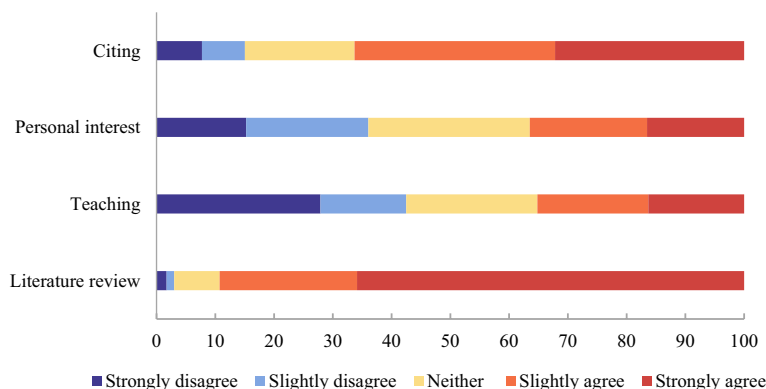


Fig. 4 Purposes of downloading research articles

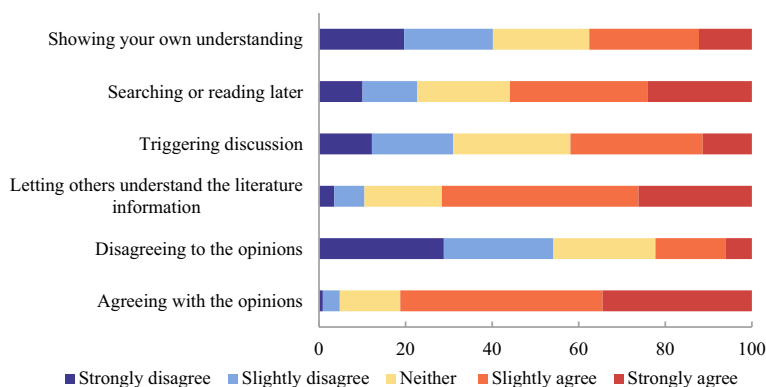


Fig. 5 Purposes of sharing research articles on OSNs

occupations for each kind of article-sharing purpose (Table S2 in Online Appendix C). Supporting staff (mostly librarians) were more likely to share articles on OSNs for the purpose of helping others understand the literature; this could be because of their professional work related to reading promotion or research consultation. Furthermore, students' average scores for the purpose of searching or reading later were greater than those for other occupations, which means that students use OSNs as a reference by sharing academic articles.

With respect to saving academic articles in the RMS (Fig. 6), citing and reading were two primary purposes, accounting for 85.26% and 80.77%, respectively. Approximately 66.35% of respondents reported that they used reference management software to save articles for the purpose of downloading them later, whereas only 31.41% saved academic articles for sharing them later. Overall, there were few differences in the average scores of different occupations for each kind of article-saving purpose (Table S3 in Online Appendix C). Nevertheless, there was a greater potential for supporting staff to share with others after saving academic articles in the RMS. Due to the information demand of scientific research, faculty and graduate students were more likely to cite or download the full text later after the article was saved.

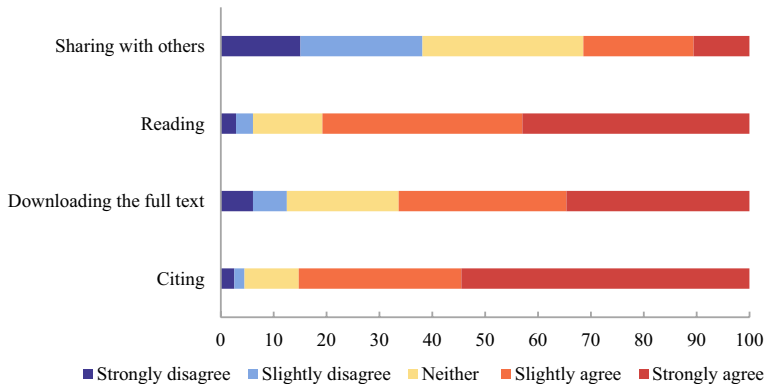


Fig. 6 Purposes of saving research articles in RMS

Effects of document characteristics

Measurement model

In this study, 11 document characteristics were used to construct attainment value, intrinsic interest value, and utility value. The construct reliability, indicator reliability, convergent validity, discriminant validity, and common method bias were measured for all multi-item measurements in three structural models for three literature usage behaviors (downloading, sharing, and saving). The construct reliability was assessed using Cronbach's α and composite reliability (CR). As shown in Table 2, the Cronbach's α values for all the constructs

Table 2 Assessment of the reliability and validity of the constructs

Constructs	Cronbach's α	CR	AVE	VIF	1	2	3	4
Model 1-Downloading								
1. Attainment value	0.756	0.837	0.568	1.328	0.754			
2. Intrinsic interest value	0.664	0.794	0.563	1.285	<i>0.346</i>	0.751		
3. Utility value	0.818	0.849	0.589	1.459	<i>0.474</i>	<i>0.445</i>	0.767	
4. Downloading frequency	1.000	1.000	1.000	–	<i>0.177</i>	<i>0.281</i>	<i>0.233</i>	1.000
Model 2-Sharing								
1. Attainment value	0.862	0.905	0.705	1.733	0.840			
2. Intrinsic interest value	0.755	0.862	0.678	1.715	<i>0.474</i>	0.824		
3. Utility value	0.890	0.922	0.746	2.278	<i>0.646</i>	<i>0.641</i>	0.864	
4. Sharing frequency	1.000	1.000	1.000	–	<i>0.256</i>	<i>0.175</i>	<i>0.197</i>	1.000
Model 3-Saving								
1. Attainment value	0.831	0.883	0.654	1.511	0.809			
2. Intrinsic interest value	0.696	0.828	0.619	1.621	<i>0.426</i>	0.787		
3. Utility value	0.872	0.893	0.680	1.978	<i>0.574</i>	<i>0.612</i>	0.825	
4. Saving frequency	1.000	1.000	1.000	–	<i>0.159</i>	<i>0.225</i>	<i>0.199</i>	1.000

The bold text represents the square roots of the AVEs, and the italic text represents the correlations

in the three models ranged from 0.664 (the intrinsic interest value of Model 1) to 0.890 (the utility value of Model 2). Although the Cronbach's α values of intrinsic interest in Model 1 and Model 3 were slightly lower than the recommended value of 0.70, they were still above the acceptable value of 0.60 for an exploratory study (Chin, 1998; Kim, 2018; Nunnally & Bernstein, 1994). All the CR values of the three models were greater than the recommended threshold of 0.70 (Chin, 1998; Kim, 2018; Nunnally & Bernstein, 1994). Therefore, the Cronbach's α and CR values in this study presented acceptable construct reliability for the multi-item measurements.

Indicator reliability was evaluated by external outer loading for each indicator (Hair et al., 2011; Zahra et al., 2022). In general, the outer loadings of the indicators were required to be higher than 0.70. However, outer loadings in the range of 0.40 to 0.70 could be recommended to remain when the value of CR (or AVE) reaches the suggested threshold (Mehdi et al., 2022). An indicator with an outer loading of less than 0.40 was eliminated. Tables S4–S6 in Online Appendix C present the outer loadings for all the indicators in the three models. The results showed that the outer loadings ranged from 0.613 to 0.904. Although the outer loadings of partial indicator values were lower than 0.7, their CR (or AVE) values were still acceptable.

The convergent validity of the constructs was mainly examined by average variance extracted (AVE) values. According to Table 2, the AVE values of the three models ranged from 0.563 (intrinsic interest value of Model 1) to 0.746 (utility value of Model 2), which exceeded the acceptable value of 0.50 (Fornell & Larcker, 1981; Hair et al., 2006; Kim, 2018). The discriminant validity of the constructs was assessed using the Fornell–Larcker criterion (Fornell & Larcker, 1981; Zahra et al., 2022). As the results show, the square roots of each construct's AVEs (the bold text in Table 2) were larger than the correlations between constructs (the italic text in Table 2). Furthermore, the heterotrait–monotrait (HTMT) ratio of correlations was also used to measure discriminant validity (Henseler et al., 2016; Zahra et al., 2022), as presented in Tables S7–S9 in Online Appendix C. The HTMT criterion values ranged from 0.155 to 0.761, which were below the 0.85 threshold (Mehdi et al., 2022). Thus, convergent and discriminant validity were both established in this study.

In the context of PLS-SEM, variance inflation factors (VIFs) were used to reflect collinearity between constructs. The VIFs greater than 5 indicated pathological collinearity, and a model was tainted by common method bias (Fong et al., 2023; Hair et al., 2017; Kyari et al., 2021). Table 2 shows that the VIFs for all the constructs were below the threshold of 5, indicating that there was no multicollinearity concern in the model.

Structural model

The quality of the structural model was assessed by examining the path coefficients (β) and variance explained (R^2) via a bootstrapping procedure in PLS-SEM. Generally, R^2 values of 0.26, 0.13 and 0.02 can be considered large, medium and weak, respectively, for testing the predictive accuracy of the model (Cohen, 1988; Zahra et al., 2022). In this study, the R^2 values of the three models for articles downloading, sharing, and saving all indicated weak degrees of predictive accuracy, 0.089, 0.069, and 0.058, respectively. To investigate the effects of document characteristics, the path coefficients from different types of value (attainment value, intrinsic interest value, and utility value) to three literature usage behaviors were examined. The path coefficients (β), t values, and p values are presented in Figs. 7, 8 and 9 and Table 3. The findings showed obvious differences in the effects

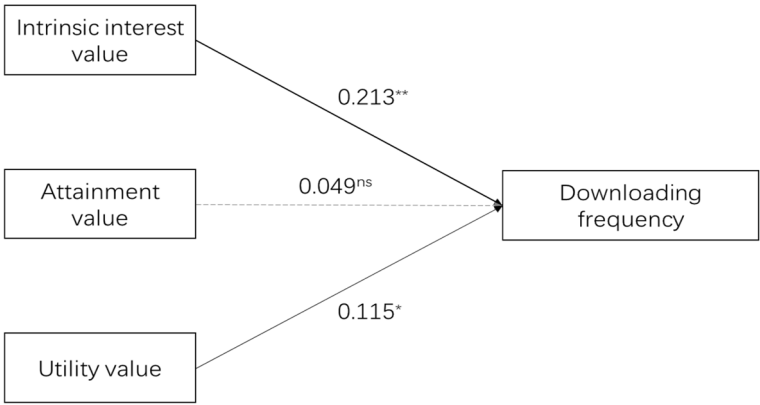


Fig. 7 Structural Model 1 for downloading (bootstrapped). *Note(s)* * $p < 0.05$, ** $p < 0.01$, and ^{ns} not significant

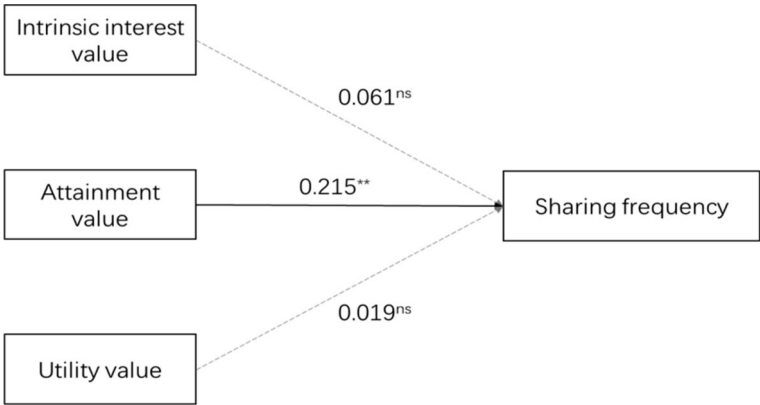


Fig. 8 Structural Model 2 for sharing (bootstrapped). *Note(s)* * $p < 0.05$, ** $p < 0.01$, and ^{ns} not significant

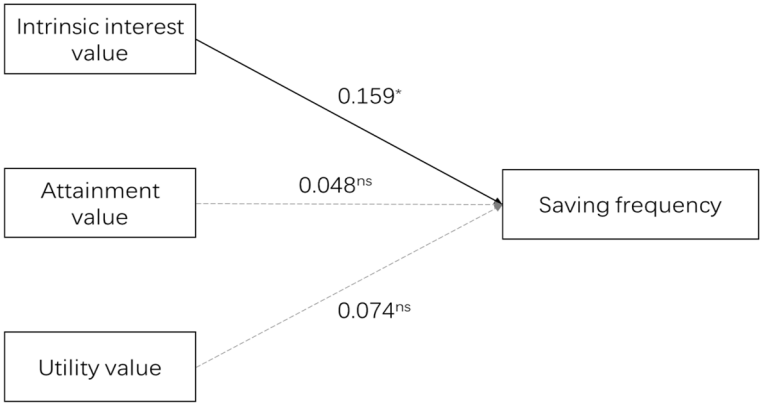


Fig. 9 Structural Model 3 for savings (bootstrapped). *Note(s)* * $p < 0.05$, ** $p < 0.01$, and ^{ns} not significant

Table 3 Structural estimates

Path	Path coefficient	<i>t</i> value	<i>p</i> value
Model 1-Downloading			
Attainment value → Downloading frequency	0.049	1.047	0.295
Intrinsic interest value → Downloading frequency	0.213	4.326**	0.000
Utility value → Downloading frequency	0.115	2.237*	0.025
Model 2-Sharing			
Attainment value → Sharing frequency	0.215	2.690**	0.007
Intrinsic interest value → Sharing frequency	0.061	0.824	0.410
Utility value → Sharing frequency	0.019	0.223	0.824
Model 3-Saving			
Attainment value → Saving frequency	0.048	0.701	0.483
Intrinsic interest value → Saving frequency	0.159	2.224*	0.026
Utility value → Saving frequency	0.074	0.858	0.391

* $p < 0.05$, and ** $p < 0.01$

of different values on different literature usage behaviors. The intrinsic interest value ($\beta = 0.213$, $t = 4.326$, $p < 0.01$) and utility value ($\beta = 0.115$, $t = 2.237$, $p < 0.05$) were found to have positive statistically significant relationships with article-downloading, whereas the attainment value was found to have no significant relationship. In terms of article-sharing, attainment value had a significant positive influence ($\beta = 0.215$, $t = 2.690$, $p < 0.01$). The intrinsic interest value had a significant positive relationship with article savings ($\beta = 0.159$, $t = 2.224$, $p < 0.05$).

Discussion

In this study, there were more members of Chinese universities who downloaded or saved scholarly articles than those who shared them on OSNs. The behavioral frequencies of downloading and saving were also greater than those of sharing. This result might seem to align with common sense, as scientific research activities are closely associated with literature reviews, which require a substantial amount of reading. For this purpose, downloading and saving research articles are essential processes, but article sharing on OSNs may not be as critical. Previous studies have also noted that some faculty members might resist or reject the use of OSNs due to considerations such as time cost, distraction, and privacy (Veletsianos & Kimmons, 2013). Moreover, the factors influencing the intention to share articles on OSNs are complex and include individual factors such as personality traits, which could have different influences on sharing intentions (Akbar et al., 2023). The inconsistency frequency among the three literature usage behaviors also implied the need to establish a comprehensive evaluation system to measure the extent to which the literature was fully used.

Graduate students were the primary users of academic literature at the daily frequency level, whether for downloading (65.06%), sharing (75.00%) or saving (52.50%). This finding aligned with prior research demonstrating that Ph.D. students are the highest users of Mendeley in all fields (Eldakar, 2019). This result was attributed to post-graduate students having more information requirements to fulfill their information

needs. Furthermore, the populations with higher frequencies of downloading, sharing and saving were mostly composed of individuals who had published as the first or corresponding authors. This suggested that publication pressure was the main cause of the literature usage in this group.

For behavioral purposes, most graduate students downloaded and saved research articles for academic purposes, such as literature reviews, citations, and readings; as mentioned above, this was mainly due to the literature requirements caused by publication pressure. Some occupation differences could be found from the purposes of literature usage. Faculty members were most likely to download research articles for teaching, aligning with their teaching responsibilities. The supporting staff were most likely to download based on their personal interests due to having less research pressure and more time for personal reading. In regard to sharing articles on OSNs, the most common reason across all occupations was agreeing with the opinions of the articles. Conversely, disagreeing with the opinions of articles was the least likely purpose, which was consistent with previous findings that researchers usually tend to avoid risks associated with criticizing previous studies as much as possible (Shema et al., 2015).

The findings suggest that there are notable differences in how document characteristics influence three literature usage behaviors (downloading, sharing, and saving); this indicated that the distinct motivations and values associated with document characteristics drove these different usage behaviors in interacting with research articles.

The article-downloading behavior was influenced significantly by intrinsic interest value and utility value, which suggested that document characteristics such as hot topics, interesting titles, topic consistency with users' research fields, high citations, high downloads, prestigious journals, and new publication time played crucial roles in attracting users to download specific publications. The findings aligned with the importance of perceived usefulness and relevance in the literature download process. In our prior study (Xiong et al., 2023), the usefulness of literature was the key factor driving users to download specific publications, as demonstrated by topic consistency, publication in high-quality journals, and being highly cited. At first glance, users were easily attracted by their citations, downloads, journal names, and publication times when they found a list of search results in the literature databases. Moreover, whether the topic was consistent with the users' field was also important. However, the effects of hot topics and interesting titles seem to be controversial issues, at least in the context of citations. Sagi and Yechiam (2008) reported that research articles with humorous titles were less frequently cited, while Heard et al. (2023) reached the opposite conclusion. This controversy emphasizes the complex nature of user behavior and preferences in scholarly article downloading.

In terms of article sharing, the results showed that attainment value significantly influenced respondents' motivation to share research articles on OSNs. Scholars preferred to share academic articles with these properties, including those shared by others, those written by certain authors or institutions, and those published early on. Article sharing on OSNs is inherently a social behavior shaped by users' social networks. If users were familiar with the authors or institutions of the research articles, then they were more likely to be shared on OSNs; they could consider this an attractive alternative to building relationships and increasing scholarly communication. According to Kim (2018), scientists who have stronger expectations for relationships in article sharing through ResearchGate are more likely to have positive attitudes toward article sharing. Moreover, it was verified that newer publications easily received more attention since social media tends to feature real-time events (Zhang & Wang, 2021). Therefore, users tend to share research articles that were more recent, capturing the trend of featuring real-time events in online environments.

With respect to article savings, the intrinsic interest value of literature was the primary driving factor for users to save them in an RMS, indicating that users were motivated to save research articles based on their perceived intrinsic interest value from these document characteristics, including interesting titles, hot topics, or topics aligned with users' study fields. Mendeley, a widely discussed reference management tool, has been identified in previous studies as a robust predictor of citations for scholarly articles (Mohammadi & Thellwall, 2014; Zahedi & Haustein, 2018). In this study, the main purpose of respondents to save articles on RMS was also to cite them in scholarly publications. Therefore, the greater the similarity of topics with users' study fields, the more likely they were to be saved in an RMS; this subsequently increased the likelihood of these articles being cited in users' publications. Additionally, not all articles saved in RMS were used to cite them in scientific practice, and some users who are attracted by interesting titles and hot topics might use these scholarly outputs for purposes other than direct citation (Eldakar, 2019).

Theoretical implications

The findings of this study shed new light on the related literature in the field of usage behavior, mainly for comparisons of different behaviors of the same individuals. First, this study identified the inconsistency in the frequency of different literature usage behaviors among the same individuals. For instance, individuals with high-frequency downloading did not necessarily reflect high-frequency sharing or saving. Consequently, a comprehensive evaluation system should be established to measure the extent to which literature is used. Second, a theoretical model grounded in expectancy-value theory was employed in this study to compare motivations for different literature usage behaviors. The results emphasized distinct motivations for three usage behaviors, namely, perceiving various aspects of value from document characteristics, which subsequently provided a novel theoretical perspective for researchers to investigate and understand the value of usage indicators generated by literature usage behavior.

Practical implications

The findings of our study have several practical implications for scientists, librarians, publishers, and policy-makers. First, the intrinsic interest value showed a positive relationship with both downloading and saving frequency. Thus, scientists can enhance the visibility and usage of their articles by focusing on using interesting titles or exploring hot topics. Second, the verified positive links between attainment value and sharing frequency also indicated that librarians and publishers could recommend user literature related to them, such as the same institute or address. Furthermore, building close social relationships with users may facilitate more effective recommendations and sharing within scholarly networks. Finally, given the inconsistency in the three types of literature usage behaviors and their distinct motivations (perceiving different values), policy-makers should establish a comprehensive evaluation to evaluate the output and performance of scientists. This system should consider multidimensional values associated with literature usage. Simultaneously, acknowledging the diversity of motivations and behaviors in scholarly communication allows for more accurate assessments of impact. Policy-makers can use this understanding to refine evaluation metrics and provide meaningful insights into the scholarly contributions of individuals.

Limitations and future research

There were several limitations that must be highlighted, as they could serve as a reference for future studies. First, the sample exhibited obvious discipline aggregation. Thus, the disciplinary differences for the three usage behaviors were not analyzed in this study. Future research may consider collecting more samples from various disciplines to the greatest extent possible. Second, questionnaire data were gathered through an online survey, and all responses were self-reported. Although the VIF results indicated that common method bias was not a significant problem in this study, it cannot be completely eliminated. Future studies may use a triangulation of methods to avoid common method bias. Finally, not all factors affecting literature usage behaviors were included in this study. Although the document characteristics used in the present study covered multiple aspects, including title, topic, author and journal levels, the number of characteristics may still be limited. Future research may overcome this limitation by adopting more new factors, such as funding, research data or methods.

Conclusion

In this study, we focused on comparing different usage behaviors of the same individual and conducted a survey of literature usage behaviors, including article-downloading, sharing, and saving, among Chinese university members. Downloading and saving behavior for scholarly articles was more frequent than sharing. The primary purpose of downloading and saving was closely related to scientific research, namely, literature reviews and citations. The most common reason for sharing was agreeing with the opinions of the articles, whereas the least common reason was disagreeing with the opinions of the articles. Additionally, we identified the effects of 11 document characteristics on three literature usage behaviors, which were classified as attainment value, intrinsic interest value, and utility value and analyzed via path analysis via PLS-SEM. To our knowledge, this is the first study to test how the effects of certain document characteristics differ across three different types of literature usage behaviors. This study concluded that intrinsic interest value and utility value both had significant positive influences on article downloading, while attainment value and intrinsic interest value showed significant relationships with sharing and saving, respectively. Overall, different usage behaviors were driven by different document characteristics. These results help to elucidate the reasonable application of usage metrics or altmetrics in scientific evaluation; furthermore, it could determine the users' motivations among multiple usage behaviors and the different aspects of literature values reflected by the usage indicators.

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Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

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