Digital Game Visual Style Classification: Influence of Information Quality Components on the User Satisfaction During Game Searching Activity in the Digital Game Library

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Abstract—The digital gaming community appreciates the visual style classification system to search for game information. However, scholars discovered that the system's inaccurate search results often dissatisfied users. So far, no studies have accurately measured user satisfaction during game searching in the existing game library. Therefore, this study was performed to investigate the influence of information quality components (Accuracy, Content, Ease of Use, Format, and Timeliness) on the User Satisfaction during game searching activity. A cross-sectional study was conducted involving Malaysian game players using a 12-item survey questionnaire based on the End-user Computing Satisfaction (EUCS) model to measure user satisfaction and information quality components. Descriptive statistics, preliminary data analysis, and Confirmatory Factor Analysis (CFA) were used to analyse the results. Out of 239 respondents, 79.1% between 19 and 24 years old have experience exploring digital games based on visual style. This research revealed that Content, Accuracy, and Ease of Use influenced User Satisfaction when searching for games based on the visual style. In contrast, the Format and Timeliness correlated weakly. Providing visual classification and appeal format has less impact on user satisfaction, while fast information retrieval and up-to-date information contributed insignificantly to user satisfaction. Future research should analyse the effectiveness of visual style information systems for digital game distribution platforms in Malaysia.

Keywords—game searching activity, digital game visual style classification, user satisfaction, digital game library, end-user computing satisfaction

1 Introduction

The use of various media platforms to search for digital game information has become increasingly important for various parties, including consumers, developers, curators, and scholars [1]–[3]. The discovery and retrieval of digital game information can be accessed from digital repositories, game marketplace, or library collections.

Nevertheless, searchable game information only provides limited access to essential information, such as title, platform, publisher, and genre [4], [5].

1.1 Related works

Recent trends have shown that video game players search for a new game product by searching the latest information based on product titles, genres, reviews, and visual screenshots of the gameplay. A recent study on genre classification highlighted the correlation between searching activity and retrieving digital games collection in a group that similarly appeals in detail [6]. Conceptually, searching for a desirable game through screenshots or trailers induces the interest of game players to play a new game while satisfying their searching needs. In addition, artistic or altruistic users' searching behaviour on digital distribution platforms improves the motivation for visual style appeal [7]. The visual aesthetic is also an essential component of visual classification, which is introduced to describe visual style classification during game searching activity [8]. Furthermore, discussion on visual styles in both academia and online community forums has indicated an interest in exploring the artistic elements and the aesthetic appeal. A recent survey on important information visual style showed that 53.4% out of 671 participants identified themselves as satisfied users [9].

Over the years, numerous studies related to web-based digital game distribution platforms have been published, including the social aspects of the gaming community [10], mining sentiment analysis [11], gamer's archetypes profiling [12], user reviews on virtual reality games [13], purchasing patterns [14], and game metadata information [9]. However, one of the overlooked aspects is the impact of digital game visual styles on user satisfaction when browsing game products. While the research direction is structured towards examining user satisfaction when they browse the digital game library to search for new game products based on the visual style classifications, there are yet any research studies that accurately measure the user satisfaction during game searching activity in the digital game library based on the visual style classification system. Although a recommendation model for game searching related to the visual style classification system was proposed, the outcome was poorly correlated with the users' satisfaction [15]. Interestingly, several experimental prototype efforts, such as Steam Experimental Lab incorporated visual style tags for game search and were documented in the public code repository [16]. Hence, there is a growing demand for a reliable game searching method with a visual style classification system that satisfies users.

1.2 Research direction

Realising the research gap, this study was performed to examine the influence of information quality components on user satisfaction during game searching activities based on the visual style classification system. In line with this main purpose, the research question is as follows: 'How do information quality components affect user satisfaction during game searching activities based on the visual style?' This research adopted the End-user Computing Satisfaction (EUCS) model to assess the correlation between information quality components (Accuracy, Content, Ease of Use, Format, and

Timeliness) and the overall User Satisfaction during game search activities based on the visual style classification system. The EUCS model by Doll and Torkzadeh [17] has been extensively applied to assess multiple web information systems, including healthcare [18], education [19], e-government [20], and e-commerce [21]. The model assesses the psychometric properties of the user satisfaction levels for cognitive and affective towards specific features in the information system [22], [23]. The results analysed the magnitude of path coefficients to provide significant areas of satisfaction or dissatisfaction by the users [24].

2 Methods

2.1 Study design

A cross-sectional survey involving a selected group of game players was conducted from September to October 2021 [25]. The participants were selected based on their knowledge of identifying visual resources as avid or casual gamers [26]. The participants should also be able to recognise terminologies related to digital games' visual arts and are familiar with conducting information searching using online digital game platforms [27]. Therefore, participants with such backgrounds are only available in institutional settings that offer game development education or digital media studies. Purposive sampling methods was used in the determination of the study group, due to the participants judgment is most suitable for the research [28], which estimates a minimum required sample size of 150 for the Structural Equation Modelling (SEM) [29]–[32]. The ethical approval for this study was obtained from the institutional research committee, while permission letters were sent to the head of programs of the respective institution and the survey was initiated once the approval letter was granted.

2.2 Pilot study

The 12-item instrument questionnaire was pre-tested on 29 game players selectively as a pilot study to assess the validity and reliability of the questionnaire and to estimate the average time for a respondent to complete the questionnaire. The respondents took an average of 15 minutes to answer the questionnaire and complete the survey.

2.3 Data collection

Self-administered survey questionnaires were distributed digitally to the respective institutions due to the imposed Movement Restriction Order following the Coronavirus disease 2019 (COVID-19) pandemic [33]. The participants were invited to join the online class session. Then, they were given a short introduction on the digital game visual style classification (http://jazmijamal.org/phd) and a brief demonstration on how to operate the visual style collection system on the web (http://jazmijamal.org/alpha). An information sheet and written consent were given to each participant and the ques-

tionnaires were distributed once the consent form was filled and submitted. A data collection session was organised using the visual style classification system to record satisfactory level from the participants. In total, the survey involved 239 respondents from 10 institutions, all of whom completed the questionnaires.

2.4 Instruments

The questionnaire consists of four main sections, namely background survey, tasks for digital game visual style system, questionnaire, and summary. The background survey section consisted of demographic and psychographic information, including gender, age category, gaming experience, and experience in searching digital game visual style information. The second section was designed for participants to operate the visual style collection system according to the listed tasks, such as inserting visual style keywords, navigating the classification tagging function, and searching for relevant information about a particular game.

The questionnaire section adopted the EUCS model with a 12-item instrument survey to determine user satisfaction [23]. Figure 1 shows the five-part questionnaire section, which includes Content, Accuracy, Format, Ease of Use, and Timeliness, each with its own list of questions. The respondents were asked to indicate the level of agreement according to the five-point Likert scale (1 = Almost never, 2 = Some of the time, 3 = About half of the time, 4 = Most of the time, and 5 = Almost always). The Likert scale estimates the user's attitudes based on the belief strength and correlates the quality attributes using experience-based computing [34]. In the summary section, the respondents were asked to rate their overall satisfaction with the visual style classification system from the second section and share their opinions and thoughts regarding the survey in the open-ended feedback section.

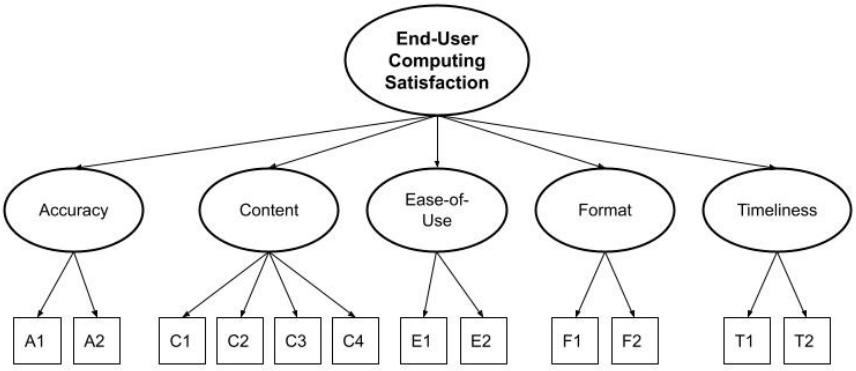

Fig. 1. EUCS model structure

2.5 Data analysis

Confirmatory Factor Analysis (CFA) was employed to examine the influence of information quality components on user satisfaction during information searching with independent variables [35]. The statistical Structural Equation Modelling (SEM) technique was also applied to assess information quality components that contribute to overall user satisfaction. As indicated in Figure 1, this research adopted the five first-order factors structure with one second-order factor model [36].

Data entries were carried out using Google Forms and Sheets. Descriptive statistics were then used to illustrate the demographic information, while categorical data were presented as percentages. In addition, data analysis was performed using the Partial Least Square with Structural Equation Modelling (PLS-SEM) to analyse the relationships between each construct of information quality components and user satisfaction [37]. This multivariate technique combines the CFA and path analysis to evaluate the causal relationships [38]. Figure 2 depicts the data analysis procedures. Moreover, the PLS-SEM calculations were carried out using SmartPLS version 3.0 [39]. The results reported the assessment of the measurement models, convergence validity, discriminant validity, and correlation coefficients.

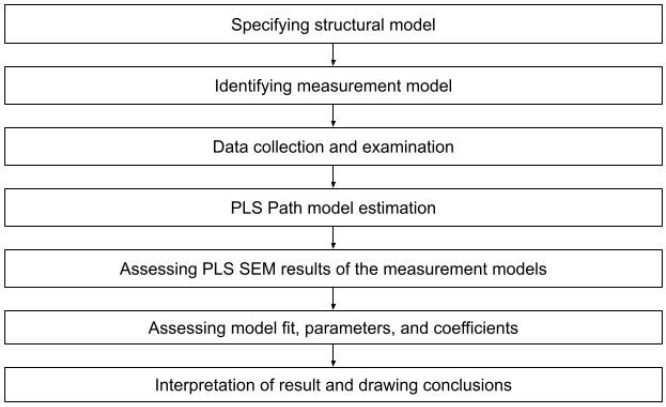

Fig. 2. Data analysis strategy for PLS-SEM

3 Analysis

This section provides the sample profile, preliminary data analysis, and SEM findings based on the online questionnaire. As shown in Table 1, the demographic analysis indicates that more than half of the 239 respondents were male (n = 139, 58.2%) with an age range between 19 and 24 years old. All respondents were currently enrolled as a student in an institution related to game development discipline. In addition, over half of the respondents have more than 4 years of experience as game enthusiasts (n = 138, 57.7%), while 79.1% (n = 189) of the respondents have experience in searching digital games under different visual styles.

Table 1. Sample demographic statistical analysis

		Frequency (n=239)	Percentage (%)
Gender	Male	139	58.2
	Female	96	40.2
	Prefer not to say	4	1.7
Age range	Under 18 years old	19	7.9
	19 - 24 years old	152	63.6
	25 - 29 years old	16	6.7
	30 - 34 years old	23	9.6
	35 - 39 years old	23	9.6
	Above 40 years old	6	2.5
Institutions	Multimedia University (Bachelor of Multimedia, Diploma of Animation)	57	23.8
	Taylor's University (Bachelor of Arts in Interactive Multimedia Design)	8	3.3
	Universiti Teknologi MARA (Bachelor of Creative Game Design)	4	4
	UOW Malaysia KDU University (Bachelor of Game Development)	2	0.8
	Management and Science University (Bachelor in Games Design and Animation)	7	2.9
	The One Academy (Bachelor of Arts in Digital Media Design)	3	3
	National Academy of Arts Culture and Heritage (Bachelor of Animation, Bachelor of Digital Games Art, Diploma in Animation)	84	84
	Selayang Community College (Diploma in Game Arts)	13	13
	Gombak Vocational College (Diploma in 3D Animation)	18	7.5
	Sultan Idris Education University (Diploma in Game Designs and Development)	19	7.9
Experience as game enthusiast	Not more than 4 years	101	42.3
	5 - 9 years	72	30.1
	10 - 15 years	43	18
	More than 16 years	23	9.6
Experience in browsing for digital game visual style	Have never used	50	20.9
	Have used but abandoned	29	12.9
	Irregular used	71	29.7
	Regular used	69	28.9
	Consistently used	20	8.4

In addition, data screening was performed as a preliminary data analysis to ensure that data were accurately measured and free of missing values and outliers [40]. Following the screening process, the result showed a minimal amount of missing data,

which was replaced using the variable median response for each measurement item. Therefore, the data was also inspected to eliminate outliers [41]. Besides, the normal data distribution was considered to remove abnormal univariate values, and the kurtosis must be within an absolute index [42]–[44]. The result of the preliminary data analysis rectified 218 samples for the SEM-PLS analysis.

Furthermore, the convergence validity test was constructed to measures the accepted factor loadings (exceed 0.6) which in this study shows from 0.795 to 0.933 [45]. Table 2 presents the cross assessment of individual reliability that includes the Average Variance Extracted (AVE) with an accepted value of more than 0.5 [46], Composite Reliability (CR) with a recommended value of 0.6 [47], and Cronbach's alpha proposed threshold value of 0.7 [48] respectively.

Table 2. Results of convergent validity

Construct	Item	Factor Loading	Average Variance Extracted (AVE)[a]	Composite Reliability (CR)[b]	Internal Reliability Cronbach's Alpha
Accuracy	A1	.908	.829	.906	.794
	A2	.912			
Content	C1	.855	.686	.897	.848
	C2	.860			
	C3	.799			
	C4	.795			
Ease of use	E1	.923	.815	.898	.776
	E2	.882			
Format	F1	.932	.869	.930	.850
	F2	.933			
Timeliness	T1	.879	.790	.883	.735
	T2	.899			

Apart from that, the discriminant validity was determined using the cross-loading Heterotrait-Monotrait ration of correlation (HTMT) to show the intercorrelations between the constructs across different variables, as presented in Table 3. The overall correlation values were between 0.484 and 0.895, which was less than 0.90 [49].

Table 3. Results of divergent validity HTMT ratio of correlations

Variables	Accuracy	Content	Ease of Use	Format	Timeliness	User Satisfaction
Accuracy						
Content	.798					
Ease of use	.723	.707				
Format	.671	.698	.797			
Timeliness	.779	.879	.835	.766		
User Satisfaction	.609	.636	.597	.553	.591	

The PLS structural model analysis specifies the relationship pattern to assess the coefficient determination, path coefficients, path significance, and predictive relevance. The structural model validation was performed with the bootstrap resampling method of 5000 subsamples with 300 iterations and stopped criterion at 7 to test the statistical significance, as recommended [50], [51].

Figure 3 shows the result of the structural model pathways. According to the findings, the path coefficients mean value indicates the regression weight relationship between the constructs in the measured model. Each construct exhibits a direct effect on User Satisfaction. Comparatively, the content recorded the highest direct effect value of 0.298, followed by Accuracy, Ease of Use, and Format of 0.180, 0.159, and 0.114, respectively. In contrast, the correlation between Timeliness and User Satisfaction recorded the least positive with a path coefficient value of 0.034. Table 4 shows the path coefficients of each construct with their respective standard deviations, T-statistics, and confidence intervals bias corrected.

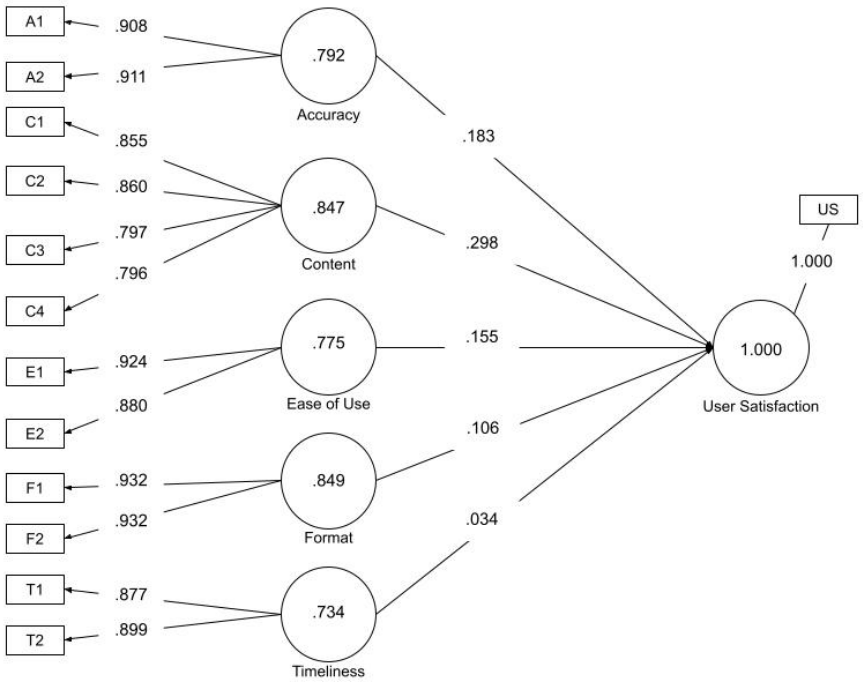

Fig. 3. PLS results of structural model pathways path coefficients

Table 4. Results of path coefficients

Variables	Path Coefficients	Standard Deviation	T Statistics	Variables	Confidence Intervals Bias Corrected	
					5%	*95%*
Content > User Satisfaction	.298	.084	3.512	.000	.152	.427
Accuracy > User Satisfaction	.183	.092	1.952	.026	.031	.334
Ease of Use > User Satisfaction	.155	.074	1.880	.030	.021	.296
Timeliness > User Satisfaction	.106	.093	1.228	.375	-.037	.270
Format > User Satisfaction	.034	.086	.320	.110	-.121	.162

The effect sizes (F^2) were also used to assess the exogenous of the individual variables. The correlations between user satisfaction and content (0.069), accuracy (0.027), and ease of (0.021) were relatively weak, while the correlations between user satisfaction and both timeliness and format variables implied a poor degree of strength. Additionally, the coefficient of determination (adjusted R^2) value for user satisfaction was 0.433 (p-value = 0.000), indicating a moderate predictive accuracy with values between 0.33 and 0.65 [52]. This model has an acceptable fit and high predictive relevance. Overall model fit Standardized Root Mean Square Residual (SRMR) indicated a model fit value of 0.060 in this study [53].

The causal effect of user satisfaction was evaluated across the five EUCS components. Based on the direct effects of the Content, Ease of Use, Timeliness, Format, and Accuracy of the structural model, three path coefficients (Content, Accuracy, and Ease of Use) were statistically significant ($p < 0.05$). Therefore, the Format showed a significant correlation with User Satisfaction at a higher p-value of 0.11, while the F^2 indicated a poor degree of strength of 0.011. Similarly, the correlation between timeliness and user satisfaction indicates low strength with an inappropriate range of p-value of 0.375.

4 Findings and discussion

This research examined the relationship between information quality components and user satisfaction when searching for digital game information based on the visual style classification system. This is the first study that explored the implementation of a digital game visual style collection system among casual video game players in Malaysia. Most of the respondents in this study were male, which was similar to the trend of respondents in a previous study conducted in Malaysia [54]. This is due to the predominantly male population in digital technology courses.

Generally, digital game players search for information about a game by identifying visual style classification characteristics to expand the discovery of visual styles that satisfy their needs. Game searching activities are categorised into several behaviours,

such as passive, active, and ongoing searching. Thus, users require an intentional impression to search for information on digital games through several phases, beginning with the desire to explore the visual style, followed by linking the visual style classification categories. Afterwards, users extract the relevant materials to verify the accuracy of the obtained information and finally retrieve the required information, thus satisfying the user's needs [55]. However, users become dissatisfied during the information search process when they obtain irrelevant and imprecise information or when the information's quality is neglected due to mental overload which they could not make the best decision due to excessive and non-specific information [56]. Confusion and the feeling of uncertainty worsen the searching experience, especially when the digital game visual style involves image or interactive artefact collections that are subjective to a broad interpretation.

According to the findings in this study, the information quality components revealed unique patterns that enhanced the satisfaction of users using information search featuring image with a specific visual style. The EUCS was employed due to its reliability and validity in independently assessing the correlation between information quality components, including Accuracy, Content, Ease of Use, Format, and Timeliness, and User Satisfaction during game searching activities. The component relationship measurement indicates the relevance of the information quality components on the visual-based search engine features of a digital game to satisfy the users' needs.

The results revealed that most of the respondents were familiar with information searching based on the visual style of digital games. The searching experience of users on the visual style is intended to either recognise the visual style classification or search for digital game-related products to establish a positive relationship with emotional experience. The visual style of a digital game benefits the overview of users on the visual style classifications as a source of reference.

Familiar users make use of the provided visual information to connect to the game's genre. When searching for games on existing digital distribution platforms, such as STEAM or Epic Games, users often experience a list of game genre selections on the search engine. Users classify digital game genres according to their shared gameplay characteristics and visual style. Genre metadata is one of the main reasons users discover games that match their preferences. Meanwhile, advanced users address the complexity of the terms associated with visual style.

To date, total of 30 visual style classifications have been expanded to encompass three facets of visual style comprising artistic style, technique, and dimension. The visual style terms should be expanded beyond and not limited to the listed classifications. However, certain visual style classifications somehow overlap similar visual style terms and meanings. Complexity in recognising an image-based visual style with overlapping information may cause feelings of uncertainty, ultimately leading to a dissatisfying user experience.

As depicted in Figure 4, the information quality components contribute to user satisfaction with the visual style classification systems for digital games. The research revealed a significant correlation between Accuracy, Content, and Ease of Use, with User Satisfaction for visual style classification systems. Conversely, Format and Timeliness showed weak correlations with user satisfaction.

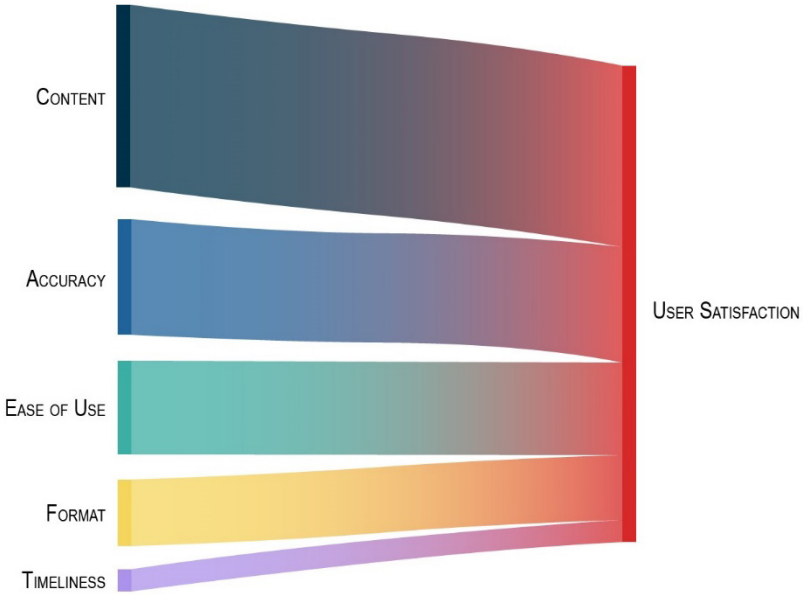

Fig. 4. Information quality components influence user satisfaction

Content is an essential information quality component, which refers to the precision and adequate information required by the user to satisfy their needs. According to the digital library collection study [57], content has the most beneficial effect on user satisfaction compared to other components. Therefore, retrieving information based on the predefined classification highly influenced user satisfaction. Hence, appealing content that suits user preference increases the interest and motivates the users [58]. The impact of content can be observed based on game titles that are used to display the notion of similar visual style.

Meanwhile, accuracy refers to intrinsic data quality that enables users to accurately retrieve relevant visual style classification information. Users address the accuracy of the visual style class system according to their needs in a state of active and ongoing search behaviour. According to digital repository study [59], users anticipate accurate and comprehensive metadata results when they retrieve information following the search activity. Accurate representation of visual image characteristics related to the terms and definition within the collective classification contribute to the emerging sense of curiosity [60]. Overall, the accurate information retrieved from various sources verifies the obtained information, satisfying the user's needs. Thus, the searching activity on visual style classification was a prevalent attribute of user satisfaction.

This study also showed the impact of the users' precise search terms on user satisfaction, whether the search was performed via text fields or navigating the tag filter features. Relevant content that provides sufficient information that meets the users' needs also contributed to user satisfaction, as similarly reported in the lifestyle mobile application study [61]. Users have more distinct and specific content selections, which

facilitate the formulation of thoughts, and provide a sense of satisfaction when the content is relevant to their needs.

Furthermore, users' deliberate exploration of additional visual style classifications in relation to genres, year of publication, and game titles provide various information access points. Previously, it was stated in the unified model of information behaviour [62] that the curiosity in game searching activities, such as identifying, formulating, evaluating, and repeating the information search, stimulates the interest of users in gaining knowledge for personal satisfaction. As a result, aesthetically appealing content stimulates the interest of users to search for more information due to immediate sensory reward [63], which in turn affects overall user satisfaction. Hence, gathering precise and sufficient visual style images increases users' motivation to continue searching and meet their needs.

Ease of use refers to the user-friendliness of the functional system based on the practical user experience quality and the ease of users to navigate the content efficiently while searching for information. It is considered effortless to learn and digest the navigation interface. This study established a significant correlation between user satisfaction and the optimised user interface, specifically for searching visual style classification. The search tag filter is composed of the visual style classification buttons on the horizontal arrays that allow users to navigate freely. In comparison to the search text fields, the users were unfamiliar with the visual style terms, which required a precise word to retrieve the classification. For example, users could not search for "minimalism" visual style because the terminology was inaccurate, which was supposed to be "minimalist". The occurrence of term errors throughout the search process induces frustration and disorientation among the users, which was similar to the user experience in a mobile web study [64]. Nevertheless, the system's interfaces adhered to user-friendliness fundamentals by considering a simple interface that makes sense for the user to navigate.

Interestingly, the results revealed that users were more satisfied with simple and functional navigation buttons, which agreed with the findings among older adults using mobile applications [65]. The composition of structured button interaction minimises the level of anxiety and disorientation, which possibly improve the motivation among users to further searching for information although the image content may not be appealing or attractive. Familiarity with the navigation interface of both the system's easy-to-use and user-friendly expectations directly influenced user satisfaction, which is in accordance with the findings using mobile news applications [66]. Hence, an easy-to-use navigation interface addressed the users' expectations and needs to search for information and influenced overall user satisfaction.

The format assessed the aesthetics of the visual style classification in providing valuable and relevant information. Presenting precise information can be useful in terms of attracting the user's attention and motivating them to interact with the content. However, it was previously reported in web-based information in academia [19] that information clarity and useful format have weak a correlation with user satisfaction.

The information format provided by the system includes a classification of visual style images grouped based on the visual style. Each digital game image contains direct links to the respective external web pages, such as the STEAM web store. Users have

suggested expanding information on visual style terms and definitions to facilitate the learning process. Moreover, adjustments may be made to improve the display format related to the metadata on visual style, genre, years, publishers, theme, and mood. Therefore, additional information would raise concerns over the transparency and sufficiency of information, which was also addressed in the mobile apps for depression [67].

Timeliness measures the responsiveness of the system in retrieving information within the timeline and up-to-date information, which positively influences user satisfaction, especially for mobile-based users [68], [69]. At present, the speed in retrieving visual style information is not an issue due to the exceptionally fast-loading image optimisation. Images are compressed so that they are compatible for web viewing under low-bandwidth internet settings. Timeliness measures the speed performance of the system acquiring information that is difficult to highlight by casual users. However, users were limited to retrieving information on the visual style classification since they were unsure whether the significant constraint is due to the speed of acquiring information from a fast server or the optimised visuals.

Timeliness also denotes the latest information regarding game products that are listed in the system. According to the study, users request the most recent game products to be included in the information retrieval database. Users anticipate real-time information updates in the existing digital game platform database. Despite the importance to provide up-to-date information, the results showed that timeliness has a lower correlation with user satisfaction. Searching for outdated information is related to casual searching behaviour without specific intention and is considered unimportant, as stated in social media web information [70]. This information searching behaviour is categorised as passive attention, where information searching is acquired subconsciously.

In short, the findings in this study justified that the information quality components, including Accuracy, Content, and Ease of Use, positively affected User Satisfaction with the visual style classification system, while Format and Timeliness indicated a weak significance with User Satisfaction. Game searching activity is dependent on the information quality components, which influence user satisfaction with visual style classification systems. The acquisition of information from the visual style classification of digital game products stimulates the interest of users to continue searching for information to meet their needs and expectations, as addressed in a study on multi-sided web platforms [71]. Therefore, the information must be precise, accurate, and sufficient to instil a positive perception and relief among users as their demands are met, hence boosting users' satisfaction, as highlighted in mobile health applications [72]. Familiar user interface and interaction experience in utilising the system also contribute to user satisfaction, which was also noted in the mobile commerce study [73]. Meanwhile, providing a user interface with visual aesthetic appeal and speed of acquiring the latest information had little correlation with user satisfaction once the system function appropriately to meet users' intentional searching needs.

4.1 Limitations

The response in this study only reflects the sentiment of a specific digital gaming community from several Malaysian education institutions. Although the demography of the respondents may differ from the digital community in other countries, this study provided valuable information regarding users' satisfaction in operating digital game visual style collection systems, which may have similar practices among digital game players in other countries. In addition, the cross-sectional assessment in this study does not represent long-term information reliability. Hence, further changes in the visual style classification that could influence the users' perception were not monitored.

5 Conclusions

The outcome assessed the user satisfaction with the visual style information associated with digital game collections. The search for information on cultural media artefacts promotes visual exploration and discovery of digital game artistry works. This exposes relevant information quality components for image-based collection, which can be considered for a web-based information system. Therefore, practical contributions adopt the use of questionnaires to evaluate the relationship between user satisfaction and the information system that supports the visual style of a digital game. Analyses of information system development could be used to incorporate the findings to create visual art information searching that provides a positive impression and satisfaction to the users. Future studies should explore and evaluate the effectiveness of visual style information systems for digital game distribution platforms in Malaysia.

In conclusion, this research highlighted the relationship between user satisfaction and information quality components on visual style classification for web game searching. This research demonstrated that information quality components, namely Content, Accuracy, and Ease of Use, influenced User Satisfaction when searching for games based on the visual style. This finding could be useful to provide further insights into the development of a comprehensive image-based collection for interactive media applications that satisfy the preference among professional game players. The study also proposed the development of a search model that emphasised the Content, Accuracy, and Ease of Use to increase User Satisfaction. Hence, the study on the impact of user experience on digital game distribution platforms may benefit the development of multiple web platforms for both mobile and desktop applications.

6 References

[1] M. A. Winget and C. Murray, "Collecting and preserving videogames and their related materials: A review of current practice, game-related archives and research projects," in *Proceedings of the ASIST Annual Meeting*, Jan. 2008, vol. 45, no. 1, pp. 1–9, https://doi.org/10.1002/meet.2008.1450450250

[2] J. Paaso-Rantala, "Legitimacy of video games as a form of art," pp. 1–48, 2016, Accessed: Jul. 01, 2021. [Online]. Available: http://www.theseus.fi/handle/10024/106665

[3] S. F. Ng, D. D. S. Anak Dawie, W. W. Chong, J. A. Jamal, S. N. A. Siti Noraisyah, and I. J. Jazmi, "Pharmacy student experience, preference, and perceptions of gaming and game-based learning," *Curr. Pharm. Teach. Learn.*, vol. 13, no. 5, pp. 479–491, May 2021, https://doi.org/10.1016/j.cptl.2021.01.019

[4] R. I. Clarke, J. H. Lee, and S. Rossi, "A qualitative investigation of users' video game information," in *Proceedings of iConference 2014*, 2015, pp. 125–139, https://doi.org/10.9776/14057

[5] J. H. Lee, A. Perti, H. Cho, A. Donovan, C. Magnifico, and K. Pittman, "Video Game Metadata Schema : Controlled Vocabulary for Visual Style," 2015. [Online]. Available: http://gamer.ischool.uw.edu/official_release/

[6] X. Li and B. Zhang, "A Preliminary Network Analysis on Steam Game Tags: Another Way of Understanding Game Genres," in *Proceedings of the 23rd International Conference on Academic Mindtrek*, 2020, pp. 65–73, https://doi.org/10.1145/3377290.3377300

[7] X. Li, C. Lu, J. Peltonen, and Z. Zhang, "A statistical analysis of Steam user profiles towards personalized gamification," in *GamiFIN Conference 2019*, 2019, pp. 217–228, Accessed: May 19, 2022. [Online]. Available: https://trepo.tuni.fi/bitstream/handle/10024/117606/a_statistical_analysis_of_steam_2019.pdf?sequence=2

[8] H. Cho, A. Donovan, and J. H. Lee, "Art in an algorithm: A taxonomy for describing video game visual styles," *J. Assoc. Inf. Sci. Technol.*, vol. 69, no. 5, pp. 633–646, May 2018, https://doi.org/10.1002/asi.23988

[9] J. H. Lee, R. I. Clarke, and A. Perti, "Empirical evaluation of metadata for video games and interactive media," *J. Assoc. Inf. Sci. Technol.*, vol. 66, no. 12, pp. 2609–2625, 2015, https://doi.org/10.1002/asi.23357

[10] M. O'Neill, E. Vaziripour, J. Wu, and D. Zappala, "Condensing Steam: Distilling the Diversity of Gamer Behavior," in *Proceedings of the 2016 Internet Measurement Conference*, 2016, pp. 81–95, https://doi.org/10.1145/2987443.2987489

[11] G. Cheuque, J. Guzmán, and D. Parra, "Recommender systems for online video game platforms: The case of steam," in *WWW '19: Companion of the World Wide Web Conference,* May 2019, pp. 763–771, https://doi.org/10.1145/3308560.3316457

[12] F. Baumann, D. Emmert, H. Baumgartl, and R. Buettner, "Hardcore Gamer Profiling: Results from an unsupervised learning approach to playing behavior on the Steam platform," *Procedia Comput. Sci.*, vol. 126, pp. 1289–1297, 2018, https://doi.org/10.1016/j.procs.2018.08.078

[13] R. Epp, D. Lin, and C.-P. Bezemer, "An Empirical Study of Trends of Popular Virtual Reality Games and Their Complaints," *IEEE Trans. Games*, vol. 13, no. 3, pp. 275–286, 2021, https://doi.org/10.1109/TG.2021.3057288

[14] S. Heo and J. Park, "Are you satisfied or satiated by the games you play? An empirical study about game play and purchase patterns by genres," *Telemat. Informatics*, vol. 59, p. 101550, 2021, https://doi.org/10.1016/j.tele.2020.101550

[15] D. Wang, M. Moh, and T.-S. Moh, "Using Deep Learning and Steam User Data for Better Video Game Recommendations," in *Proceedings of the 2020 ACM Southeast Conference*, 2020, pp. 154–159, https://doi.org/10.1145/3374135.3385283

[16] Valve Corporation, "STEAM." 2020, [Online]. Available: https://store.steampowered.com/.

[17] W. J. Doll and G. Torkzadeh, "The measurement of End-User Computing Satisfaction," *MIS Q.*, vol. 12, no. 2, pp. 259–274, 1988, [Online]. Available: https://www.jstor.org/stable/248851

[18] L. R. Kalankesh, Z. Nasiry, R. A. Fein, and S. Damanabi, "Factors influencing user satisfaction with information systems: A systematic review," *Galen Med. J.*, 2020, Accessed: Jul. 01, 2021. https://doi.org/10.31661/gmj.v9i0.1686

[19] Purwanto and P. B. Deden Hedin, "Measurement of user satisfaction for web-base academic information system using end-user computing satisfaction method," in *IOP Conference Series: Materials Science and Engineering*, Dec. 2020, vol. 909, no. 1, p. 012044, https://doi.org/10.1088/1757-899X/909/1/012044

[20] E. Sorongan and Q. Hidayati, "Integration of eucs variables into delone and mclean models for E-government evaluation: Conceptual models," *Regist. J. Ilm. Teknol. Sist. Inf.*, vol. 6, no. 1, pp. 32–42, Jan. 2020, https://doi.org/10.26594/register.v6i1.1608

[21] S. F. Abdinnour-Helm, B. S. Chaparro, and S. M. Farmer, "Using the End-User Computing Satisfaction (EUCS) instrument to measure satisfaction with a web site," *Decis. Sci.*, vol. 36, no. 2, pp. 341–364, 2005, https://doi.org/10.1111/j.1540-5414.2005.00076.x.

[22] M. Gelderman, "The relation between user satisfaction, usage of information systems and performance," *Inf. Manag.*, vol. 34, no. 1, pp. 11–18, Aug. 1998, https://doi.org/10.1016/S0378-7206(98)00044-5

[23] B. Prasetyo, R. W. E. Yulia, and Felisia, "Measuring end-user satisfaction of online marketplace using end-user computing satisfaction model (EUCS Model) (Case study: Tokopedia.com)," in *Proceedings of the 2017 4th International Conference on Computer Applications and Information Processing Technology, CAIPT 2017*, Mar. 2018, vol. 2018-January, pp. 1–5, https://doi.org/10.1109/CAIPT.2017.8320710

[24] V. P. Aggelidis and P. D. Chatzoglou, "Hospital information systems: Measuring end user computing satisfaction (EUCS)," *J. Biomed. Inform.*, vol. 45, no. 3, pp. 566–579, Jun. 2012, https://doi.org/10.1016/j.jbi.2012.02.009

[25] C. K. Bak *et al.*, "Digital Health Literacy and Information-Seeking Behavior among University College Students during the COVID-19 Pandemic: A Cross-Sectional Study from Denmark," *Int. J. Environ. Res. Public Health*, vol. 19, no. 6, p. 3676, 2022, https://doi.org/10.3390/ijerph19063676

[26] J. H. Lee, H. Cho, V. Fox, and A. Perti, "User-centered approach in creating a metadata schema for video games and interactive media," *Proc. ACM/IEEE Jt. Conf. Digit. Libr.*, pp. 229–238, 2013, https://doi.org/10.1145/2467696.2467702

[27] M. B. Oliver, N. D. Bowman, J. K. Woolley, R. Rogers, B. I. Sherrick, and M.-Y. Chung, "Video games as meaningful entertainment experiences.," *Psychol. Pop. Media Cult.*, vol. 5, no. 4, pp. 390–405, Oct. 2016, https://doi.org/10.1037/ppm0000066

[28] T. Karakose, H. Polat, and S. Papadakis, "Examining Teachers' Perspectives on School Principals' Digital Leadership Roles and Technology Capabilities during the COVID-19 Pandemic," *Sustainability*, vol. 13, no. 23, p. 13448, 2021, https://doi.org/10.3390/su132313448

[29] H. E. A. Tinsley and D. J. Tinsley, "Uses of factor analysis in counseling psychology research," *J. Couns. Psychol.*, vol. 34, no. 4, pp. 414–424, Oct. 1987, https://doi.org/10.1037/0022-0167.34.4.414

[30] L. Ding, W. F. Velicer, and L. L. Harlow, "Effects of estimation methods, number of indicators per factor, and improper solutions on Structural Equation Modeling fit indices," *Struct. Equ. Model. A Multidiscip. J.*, vol. 2, no. 2, pp. 119–143, Jan. 1995, https://doi.org/10.1080/10705519509540000

[31] L. K. Muthén and B. O. Muthén, "How to use a Monte Carlo study to decide on sample size and determine power," *Struct. Equ. Model.*, vol. 9, no. 4, pp. 599–620, 2002, https://doi.org/10.1207/S15328007SEM0904_8

[32] E. J. Wolf, K. M. Harrington, S. L. Clark, and M. W. Miller, "Sample size requirements for Structural Equation Models: An evaluation of power, bias, and solution propriety," *Educ. Psychol. Meas.*, vol. 73, no. 6, pp. 913–934, Jul. 2013, https://doi.org/10.1177/0013164413495237

[33] T. Karakosa, T. Y. Ozdemir, S. Papadakis, R. Yirci, S. E. Ozkaryan, and H. Polat, "Investigating the Relationships between COVID-19 Quality of Life, Loneliness, Happiness, and Internet Addiction among K-12 Teachers and School Administrators—A Structural Equation Modeling Approach," *Int. J. Environ. Res. Public Health*, vol. 19, no. 1052, 2022, https://doi.org/10.3390/ijerph19031052

[34] G. Torkzadeh and W. J. Doll, "Test-Retest Reliability of the End-User Computing Satisfaction Instrument," *Decis. Sci.*, vol. 22, no. 1, pp. 26–37, Jan. 1991, https://doi.org/10.1111/j.1540-5915.1991.tb01259.x

[35] D. Kaplan, *Structural Equation Modeling: Foundation and Extensions*, 2nd ed. USA: SAGE Publications, 2009.

[36] K.-S. Lim, J.-S. Lim, and J. H. Heinrichs, "Validating an End-User Computing Satisfaction instrument: A confirmatory factor analysis approach using international data," *J. Int. Technol. Inf. Manag.*, vol. 17, no. 2, pp. 153–165, Jan. 2008, Accessed: Jul. 01, 2021. [Online]. Available: https://scholarworks.lib.csusb.edu/jitim/vol17/iss2/6

[37] C. M. Ringle, M. Sarstedt, and D. W. Straub, "A critical look at the use of PLS-SEM in MIS quarterly," *MIS Q. Manag. Inf. Syst.*, vol. 36, no. 1, Mar. 2012, https://doi.org/10.2307/41410402

[38] Y. Fan *et al.*, "Applications of structural equation modeling (SEM) in ecological studies: an updated review," *Ecol. Process.*, vol. 5, no. 1, pp. 1–12, Dec. 2016, https://doi.org/10.1186/s13717-016-0063-3

[39] J. F. Hair, J. G. Tomas, G. T. M. Hult, C. Ringle, and M. Sarstedt, *A primer on partial least* squares *structural equation modeling (PLS-SEM)*. USA: SAGE Publications, 2014.

[40] J. Hair, C. L. Hollingsworth, A. B. Randolph, and A. Y. L. Chong, "An updated and expanded assessment of PLS-SEM in information systems research," *Ind. Manag. Data Syst.*, vol. 117, no. 3, pp. 442–458, 2017, https://doi.org/10.1108/IMDS-04-2016-0130

[41] J. Hair, W. C. Black, B. J. Babin, and R. E. Anderson, *Multivariate data analysis*, 7th ed. New Jersey: Pearson Education Inc, 2010.

[42] R. B. Kline, *Principles and Practice of Structural Equation Modeling*, 4th ed. Montreal: The Guilford Press, 2015.

[43] R. Yadav and G. S. Pathak, "Young consumers' intention towards buying green products in a developing nation: Extending the theory of planned behavior," *J. Clean. Prod.*, vol. 135, pp. 732–739, Nov. 2016, https://doi.org/10.1016/j.jclepro.2016.06.120

[44] S. Papadakis and M. Kalogiannakis, "Evaluating the effectiveness of a game-based learning approach in modifying students' behavioural outcomes and competence, in an introductory programming course. A case study in Greece," *Int. J. Teach. Case Stud.*, vol. 10, no. 3, pp. 235–250, 2019, https://doi.org/10.1504/IJTCS.2019.10024369

[45] J. F. Hair, G. T. Hult, C. M. Ringle, and M. Sarstedt, *A primer on partial least square structural equation modeling (PLS-SEM)*. Sage: Thousand Oaks, 2017.

[46] N. Urbach and F. Ahlemann, "Structural Equation Modeling in information systems research using Partial Least Squares," *J. Inf. Technol. Theory Appl.*, vol. 11, no. 2, Oct. 2010, Accessed: Jul. 02, 2021. [Online]. Available: https://aisel.aisnet.org/jitta/vol11/iss2/2

[47] R. P. Bagozzi and Y. Yi, "On the evaluation of structural equation models," *J. Acad. Mark. Sci.*, vol. 16, no. 1, pp. 74–94, Mar. 1988, https://doi.org/10.1007/BF02723327

[48] J. C. Nunnally and I. H. Bernstein, *Psychometric Theory*. New York: McGraw-Hill, 1994.

[49] J. Henseler, C. M. Ringle, and M. Sarstedt, "A new criterion for assessing discriminant validity in variance-based structural equation modeling," *J. Acad. Mark. Sci.*, vol. 43, no. 1, pp. 115–135, Jan. 2015, https://doi.org/10.1007/s11747-014-0403-8

[50] W. W. Chin, "How to write up and report PLS analyses.," in *Handbook of partial least squares*, Springer, 2010, pp. 655–690. https://doi.org/10.1007/978-3-540-32827-8_29

[51] C. M. Ringle, S. Wende, and J. M. Becker, *Smart PLS3*. Germany: SmartPLS GmBH, 2015.
[52] W. W. Chin, "The partial least squares approach to structural equation modeling," in *In Modern Methods for Business Research*, New Jersey: Lawrence Erlbaum Associates, 1998, pp. 1295–1336.
[53] J. Henseler *et al.*, "Common Beliefs and Reality About PLS: Comments on Rönkkö and Evermann (2013)," *Organ. Res. Methods*, vol. 17, no. 2, pp. 182–209, 2014, https://doi.org/10.1177/1094428114526928
[54] C. Wee and K. M. Yap, "Gender Diversity in Computing and Immersive Games for Computer Programming Education: A Review," *Int. J. Adv. Comput. Sci. Appl.*, vol. 12, no. 5, pp. 477–487, 2021, [Online]. Available: https://pdfs.semanticscholar.org/e865/71e288f00bda6d4ba51617a14c3a24122b18.pdf
[55] Y. Karauna, "Analisis Kepuasan Mahasiswa Universitas Buddhi Dharma Terhadap Repositori Perpustakaan dengan Menggunakan Model EUCS," *BIBLIOTIKA J. Kaji. Perpust. dan Inf.*, vol. 6, no. 1, pp. 124–137, 2022, [Online]. Available: http://journal2.um.ac.id/index.php/bibliotika/article/view/28681
[56] A. C. Smith *et al.*, "Digital Overload among College Students: Implications for Mental Health App Use," *Soc. Sci.*, vol. 10, no. 8, 2021, https://doi.org/10.3390/socsci10080279
[57] M. Iqbal, M. Rafiq, and S. H. Soroya, "Examining predictors of digital library use: an application of the information system success model," *Electron. Libr.*, vol. ahead-of-p, no. ahead-of-print, Jan. 2022, https://doi.org/10.1108/EL-01-2022-0008
[58] I. Katsaris and N. Vidakis, "Adaptive e-Learning Systems Through Learning Styles: A Review of the Literature," *Adv. Mob. Learn. Educ. Res.*, vol. 1, no. 2, pp. 124–145, 2021, https://doi.org/10.25082/AMLER.2021.02.007
[59] M. Buranarach, W. Buranasing, S. Rungcharoensuksri, P. Sarawasee, T. Ngootip, and W. Chansanam, "Metadata Integration Framework for Data Integration of Socio-Cultural Anthropology Digital Repositories: A Case Study of Princess Maha Chakri Sirindhorn Anthropology Centre," *Informatics*, vol. 9, no. 2, 2022, https://doi.org/10.3390/informatics9020038
[60] S. Van de Cruys, C. Damiano, Y. Boddez, M. Król, L. Goetschalckx, and J. Wagemans, "Visual affects: Linking curiosity, Aha-Erlebnis, and memory through information gain," *Cognition*, vol. 212, p. 104698, 2021, https://doi.org/10.1016/j.cognition.2021.104698
[61] K.-L. Hsiao, K.-Y. Lin, Y.-T. Wang, C.-H. Lee, and Z.-M. Zhang, "Continued use intention of lifestyle mobile applications: the Starbucks app in Taiwan," *Electron. Libr.*, vol. 37, no. 5, pp. 893–913, Jan. 2019, https://doi.org/10.1108/EL-03-2019-0085
[62] N. K. Agarwal, "Integrating models and integrated models: towards a unified model of information seeking behaviour," *Inf. Res.*, vol. 27, no. 1, 2022, https://doi.org/10.47989/irpaper922
[63] A. A. Brielmann and P. Dayan, "A computational model of aesthetic value.," *Psychol. Rev.*, p. No Pagination Specified-No Pagination Specified, 2022, https://doi.org/10.1037/rev0000337
[64] G. de Andrade Cardieri and L. M. Zaina, "Analyzing User Experience in Mobile Web, Native and Progressive Web Applications: A User and HCI Specialist Perspectives," 2018, https://doi.org/10.1145/3274192.3274201
[65] Q. Li and Y. Luximon, "Navigating the Mobile Applications: The Influence of Interface Metaphor and Other Factors on Older Adults' Navigation Behavior," *Int. J. Human–Computer Interact.*, pp. 1–17, Apr. 2022, https://doi.org/10.1080/10447318.2022.2050540
[66] F. Guo, J. Chen, M. Li, W. Lyu, and J. Zhang, "Effects of visual complexity on user search behavior and satisfaction: an eye-tracking study of mobile news apps," *Univers. Access Inf. Soc.*, 2021, https://doi.org/10.1007/s10209-021-00815-1

[67] K. O'Loughlin, M. Neary, E. C. Adkins, and S. M. Schueller, "Reviewing the data security and privacy policies of mobile apps for depression," *Internet Interv.*, vol. 15, pp. 110–115, 2019, https://doi.org/10.1016/j.invent.2018.12.001

[68] F. Wijaya, S. A. Solikhatin, and cImam Tahyudin, "Analysis of End-user Satisfaction of Zoom Application for Online Lectures," in *2021 3rd East Indonesia Conference on Computer and Information Technology (EIConCIT)*, 2021, pp. 348–353, https://doi.org/10.1109/EIConCIT50028.2021.9431903

[69] K. Zhang and P. Lu, "What are the key indicators for evaluating the service satisfaction of WeChat official accounts in Chinese academic libraries?," *Libr. Hi Tech*, vol. ahead-of-p, no. ahead-of-print, Jan. 2022, https://doi.org/10.1108/LHT-07-2021-0218

[70] K. Li, C. Zhou, X. (Robert) Luo, J. Benitez, and Q. Liao, "Impact of information timeliness and richness on public engagement on social media during COVID-19 pandemic: An empirical investigation based on NLP and machine learning," *Decis. Support Syst.*, p. 113752, 2022, https://doi.org/10.1016/j.dss.2022.113752

[71] W. Liu and H.-P. Shih, "How do search-based and experience-based information matter in the evaluation of user satisfaction? The case of TripAdvisor," *Aslib J. Inf. Manag.*, vol. 73, no. 5, pp. 659–678, Jan. 2021, https://doi.org/10.1108/AJIM-03-2021-0093

[72] S. Hajesmaeel-Gohari, F. Khordastan, F. Fatehi, H. Samzadeh, and K. Bahaadinbeigy, "The most used questionnaires for evaluating satisfaction, usability, acceptance, and quality outcomes of mobile health," *BMC Med. Inform. Decis. Mak.*, vol. 22, no. 1, p. 22, 2022, https://doi.org/10.1186/s12911-022-01764-2

[73] A. A. Vărzaru, C. G. Bocean, C. C. Rotea, and A.-F. Budică-Iacob, "Assessing Antecedents of Behavioral Intention to Use Mobile Technologies in E-Commerce," *Electronics*, vol. 10, no. 18, 2021, https://doi.org/10.3390/electronics10182231

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