Research on QoE Evaluation Index of Online Music Service

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Abstract. Online music service is one of the most popular kinds of online services. To analyze the quality of end user experience, we investigate the quality of experience (QoE) index of these services. Based on the SERVPERF model, we collect data from college students and obtain weights of key factors. A hierarchical QoE index system is proposed in this paper. Using this QoE index system, we comparing several popular online music services, and give some improvement suggestion to these services.

Keywords: Online music · Quality of experience · Quality evaluation

1 Introduction

With the rapid development of network technology, the transmission mode of music works has also changed. The music industry has ushered in the Internet era and the network music platform has gradually become the main way for people to listen to music [1–3]. Nowadays, online music copyright is gradually becoming standardized, and the market competition of online music platform is becoming increasingly fierce. In this case, the performance of the network music platform service is very important, it may affect the user stickiness [4]. In the performance of online music platform, there are mainly six important performances, namely assurance, security, reliability, use experience, value-added services, and functionality. These six important properties can be refined again. The study found that the network music platform needs to pay attention to strengthen its security and guarantee, and expand its functionality. Through these studies, we can promote each network music platform to enhance its value and development potential to improve the competitiveness. On this basis, college students account for a large proportion of users, and the performance they pay attention to becomes particularly important [5]. Therefore, it is of great practical significance to study the service evaluation index system of music platform service for college students.

Common methods of user experience evaluation mainly include subjective evaluation method, behavioral data method, interview method, literature method, questionnaire method and physiological method [6]. By using the above methods, we can know all the

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feelings of users when using the network music platform. In the process of establishing the index system, it is necessary to design a set of index system first, and then the index system can be obtained after expert rating and analysis [7]. In this study, interview method, literature method, questionnaire survey method and analytic hierarchy process were adopted to conduct a sampling survey with college students as the sample population. Through literature, interviews and analysis, 6 first-level indicators and 17 s-level indicators were finally established, which made the index system more objective and reasonable. Reliability analysis, validity analysis, consistency analysis, determination of index weight and other calculation and analysis were carried out on the questionnaire results. Reliability analysis makes the research results stable and reliable, validity analysis reflects the effectiveness of the research results [8, 9], and consistency complex analysis and the determination of index weight make the results authentic and accurate. The analytic hierarchy process (AHP) provides a scientific basis for the research results. Through the above methods, relatively accurate research results can be obtained [10].

It can be seen from the results of this survey that college students pay more attention to the security, assurance and functionality of music platforms when they use them. The network music platform can improve these three aspects to enhance the user's service experience and user stickiness. This survey provides future improvement directions for all online music platforms, provides reference for promoting the development of online music platforms to meet the multi-level personalized users, and promotes the positive circular development of platform ecosystem.

2 Investigation Methods

The service of online music platform is different from the SERVPERF model, so according to the model, some experiential perception indicators are discarded, and some networked first-level indicators are added according to the particularity of online music platform and user needs. Then through the literature method and interview method to the primary index characteristics of more comprehensive addition. In this paper, six college students with inconsistent frequency of using online music were carefully selected for face-to-face interviews to collect better and reasonable indicators based on user needs. For preliminary build a platform for the online music service evaluation index, design questionnaire, please users according to their own understanding, in accordance with the indicators on the importance of the network music platform service indicators, to rate and the correlation of evaluation system, in this preliminary investigation, according to user's evaluation result to calculate the variation coefficient of each index and arithmetic mean, To determine the degree of user adjustment and user opinion uniformity. The smaller the arithmetic mean is, the lower the perception of this indicator is in the user's eyes, so it can be deleted. The degree of coordination is inversely proportional to the coefficient of variation, the greater the coefficient, the greater the divergence of users, and vice versa. Uniformity of user opinion M_y:

$$M_y = \frac{1}{m_y} \sum\nolimits_{x-1}^{m_x} C_{xy} \quad y = 1, 2, 3, \ldots\ldots, n. \tag{1}$$

M_y is the arithmetic mean of the score of y indicator. m and C respectively represent the number of users and the rating of indicators. The larger the value of M_y, the more

important the indicator is in the evaluation of online music platform services, and the smaller the value of M_y, the smaller the influence of the indicator on the evaluation of online music platform services. For the coordination degree of users' opinions V_y, the coefficient of variation β_y of the index score was calculated first:

$$\beta_y = \sqrt{\frac{1}{m_y - 1} \sum_{x-1}^{m_i} \left(C_{xy} - M_y\right)^2} \quad y = 1, 2, 3, \ldots\ldots, n \tag{2}$$

M_y and β_y to calculate the user opinion coordination degree V_y:

$$V_y = \frac{\beta_y}{M_y} \quad y = 1, 2, 3, \ldots\ldots, n. \tag{3}$$

If the users' consensus degree M_y is more than 4.0, it means that the overall evaluation index system of online music platform service has a high degree of recognition. In the degree of coordination of users' opinions V_y, all indicators are lower than 0.2, which means that there are few divergent opinions on various indicators. After investigation, this index system has a higher rationality.

If the order n of the judgment matrix is greater than 2, it will bring some difficulties to obtain the consistency result of the constructed judgment matrix, so it is necessary to carry out consistency test. First, the maximum Eigen root of λ_{max-n} order judgment matrix A is calculated by the formula:

$$\lambda_{max} = \frac{1}{n} \sum_{i=0}^{n} \frac{(A \cdot W)}{Wi}. \tag{4}$$

Wi is the weight of each index. Find the magnitude of CI:

$$CI = \frac{(\lambda_{max} - n)}{n - 1}. \tag{5}$$

The smaller the CI, the greater the consistency. Considering that the deviation of consistency may be caused by random reasons, it is necessary to compare CI with the average random consistency index RI to get the test coefficient CR when testing whether the judgment matrix has satisfactory consistency CR:

$$CR = \frac{CI}{RI}. \tag{6}$$

The random consistency ratio CR, that is, when $CR < 0.10$, the judgment matrix passes the consistency test.

Indicator specified processing process is shown in the following table (Figs. 1 and 2):

Step 1	Based on the SERVPERF model, six first-level indexes are selected in combination with the particularity of online music platform services and user needs.
Step 2	Six college students who have been using online music platforms for a long time were carefully selected for face-to-face interviews to understand their feelings about using online music platforms and discuss the most important performance of online music platforms in their opinion.
Step 3	The main views obtained from the interview were summarized and classified into secondary indicators under the primary indicators by combining with literature, and 17 secondary indicators were obtained.

Fig. 1. Indicators specify the process flow

Step1	Questionnaires were designed according to Likert 5-point scale, with scores set at 1-5, respectively representing "very unimportant, unimportant, average, important and very important".[11]
Step2	Six college students using online music platform were selected to score the indicators of online music platform.
Step3	According to the score data collected, the index of user opinion uniformity degree M_y and user opinion coordination degree V_y were calculated by formulas (1), (2) and (3), which were compared with the standard value to analyze whether it was reasonable.
Step4	Based on the reasonable results, the established index system will be adjusted. After the adjustment, the quality investigation will be conducted until all the indicators are reasonable, and the evaluation index system of online music platform service will be obtained.
Step5	89 preliminary questionnaires were released and recovered. SPSS 22.0 was used to conduct reliability analysis and validity analysis on the evaluation index system to check whether the index system reached the standard.
Step6	The 1-9 scale method proposed by T.L. SSSTY was used to carry out comparative analysis among various indicators, and questionnaires were designed, 6 copies were issued and recovered, and the weight of indicators at all levels was calculated.[12]
Step7	Consistency test was carried out through (4), (5) and (6) to check the degree of coordination among various indicators.

Fig. 2. Quality investigation flow

The final evaluation index of online music platform service (Table 1):

Table 1. Key evaluation index of online music platform service

Level indicators	The secondary indicators
Security A	Security of downloading stored music A1
	Security of identity information and authorization A2
	Market Regulation A3
Reliability B	System stability B1
	Disaster strategy B2
	Persistent B3
Interaction experience C	Mobile demand C1
	The user interface C2
	Response and transmission speed C3
Value-added features D	Function of privilege D1
	Privacy D2
Functionality E	Music search and share E1
	Backup synchronization E2
	Features E3
Guarantee F	Compensatory F1
	Version update F2
	Product brand and strength F3

3 Results Analysis

3.1 Indicator Analysis

According to the suggestion of Tinsley (1987), 85 samples will be considered in this paper, as the ratio between the number of questions and the number of samples is about 1:5–1:10. The created questionnaires will be distributed to full-time students through electronic questionnaires and other means. There are 89 questionnaires collected this time, all of which are valid. The results of the questionnaire were imported into SPSS 22.0 for reliability analysis and validity analysis. Reliability analysis is to determine the stability of the questionnaire by calculating the obtained data results and output data results. The evaluation results of the same survey object on the same index reflect the strength of the consistency trend. Cronbach α coefficient of the first-level indexes are respectively 0.972 for safety, 0.971 for reliability, 0.968 for use experience, 0.960 for value-added services, 0.975 for functionality and 0.973 for assurance. If the values of all indicators are greater than 0.9 and the overall questionnaire is also greater than 0.9, it can be verified that the reliability of the indicator system is extremely high. Validity, also known as validity, means the use of certain measurement methods and tools to measure the accuracy of the detected things. Each index in this paper is directly measured, and the main test is the content validity and structure validity of the questionnaire. KMO value

is used to judge validity; common degree value is used to exclude unreasonable research items; variance interpretation rate value is used to illustrate the level of information extraction; factor loading coefficient is used to measure the corresponding relationship between factor (dimension) and item. KMO value is 0.744, greater than 0.6, indicating that data has validity. Therefore, the indexes determined in this paper are reasonable.

Secondly, the judgment matrix of evaluation index of network music platform is constructed, and the 1–9 scaling method proposed by T.L.ssty is used to conduct comparative analysis among various indicators. The weight of each indicator is shown in the table, and the CR value of consistency test is lower than 0.1, indicating good consistency.

Finally, it calculates the weight distribution of the second-level index in the first-level evaluation index and the weight distribution of the first-level evaluation index in the overall objective evaluation index. The product is the combined weight of the second-level evaluation index, as shown in the table, to determine the final weight of each index in the evaluation (Table 2).

Table 2. The weight of each level of indicators.

Level indicators	Weight right	The secondary indicators	Weight right	The comprehensive weights
A	0.33325	A1	0.14286	0.047608095
		A2	0.42857	0.142820953
		A3	0.42857	0.142820953
B	0.15462	B1	0.42857	0.066265493
		B2	0.14286	0.022089013
		B3	0.42857	0.066265493
C	0.06927	C1	0.2605	0.018044835
		C2	0.10616	0.007353703
		C3	0.63335	0.043872155
D	0.04619	D1	0.25	0.0115475
		D2	0.75	0.0346425
E	0.21993	E1	0.14286	0.0314192
		E2	0.42857	0.0942554
		E3	0.42857	0.0942554
F	0.17673	F1	0.42857	0.075741176
		F2	0.42857	0.075741176
		F3	0.14286	0.025247648

3.2 QoE Analysis

In the modern music dissemination way change trend, the expansion of market exploded, each big manufacturer began to flock to enter the market, and the competition is fierce, the manufacturers in order to fight for market limited customer successively introduced each has its own characteristic service, in order to stand out in a wave of music network platform. However, the features of these online music platforms are often very similar

in functionality, which makes it difficult for consumers to choose between them in a chaotic and complex market.

In this paper, the representative online music platforms in China are netease cloud, QQ music and Kugou music. This paper will study and analyze the four representative service providers of network music service platform, including netease cloud, QQ music, Kugou music and Kuwo music.

After determining the sample, it is followed by a judgment score for each secondary index. The evaluators of this questionnaire survey are mainly frequent users of online music platforms, almost college students. This paper will publish questionnaires for each sample to conduct investigation and ensure validity.

In qualitative index of the evaluation, five-point scale is adopted for each secondary index to describe five-level degree of importance, we ranked according to their own understanding, to sample each to the importance of the evaluation index, and the reference index, score of each index, and then multiplied by the weight of the index and then it is concluded that the overall score, The scoring results of each index were weighted by 15 surveyors, and then the scores of each index were obtained by multiplying the weights of the corresponding indexes. Finally, the comprehensive scores were summarized (Table 3).

Table 3. Collected values of indicators.

The secondary indicators	Netease cloud	QQ music	Kuwo music	Kugou music
A1	4.5	4.4	4.3	4.3
A2	4.6	4.3	4.3	4.2
A3	3.8	3.2	3.5	3.3
B1	4.5	4.3	4.3	4.4
B2	4.1	4.0	3.8	3.7
B3	4.2	3.9	3.7	3.8
C1	4.6	4.5	4.2	4.3
C2	4.7	4.5	3.9	3.9
C3	3.7	3.8	3.2	3.5
D1	4.5	4.3	4.0	3.9
D2	4.5	4.4	4.0	3.9
E1	4.5	4.3	3.8	3.9
E2	4.3	4.2	4.0	4.1
E3	4.6	4.1	3.8	3.8
F1	3.9	4.0	4.1	4.2
F2	4.6	4.5	3.8	3.7
F3	4.3	4.1	3.5	3.4

Based on the collated data set, the score of each secondary index of the sample product is firstly calculated, and then the total score is calculated by weighting the score. Other sample products shall be settled according to this calculation method (Table 4):

Table 4. The scores of each secondary indicators.

Secondary indicators	Score	Netease cloud	QQ music	Kuwo Music	Kugou music
A1	0.047608095	0.214236428	0.209476	0.204715	0.204715
A2	0.142820953	0.656976384	0.61413	0.61413	0.599848
A3	0.142820953	0.542719621	0.457027	0.499873	0.471309
B1	0.066265493	0.298194719	0.284942	0.284942	0.291568
B2	0.022089013	0.090564953	0.088356	0.083938	0.081729
B3	0.066265493	0.278315071	0.258435	0.245182	0.251809
C1	0.018044835	0.083006241	0.081202	0.075788	0.077593
C2	0.007353703	0.034562404	0.033092	0.028679	0.028679
C3	0.043872155	0.162326974	0.166714	0.140391	0.153553
D1	0.0115475	0.05196375	0.049654	0.04619	0.045035
D2	0.0346425	0.15589125	0.152427	0.13857	0.135106
E1	0.0314192	0.1413864	0.135103	0.119393	0.122535
E2	0.0942554	0.40529822	0.395873	0.377022	0.386447
E3	0.0942554	0.43357484	0.386447	0.358171	0.358171
F1	0.075741176	0.295390586	0.302965	0.310539	0.318113
F2	0.075741176	0.34840941	0.340835	0.287816	0.280242
F3	0.025247648	0.108564886	0.103515	0.088367	0.085842

According to the index hierarchy design of the network music platform service evaluation index system, combined with the weight calculation results of the secondary indexes A1–F3, the results of the first-level index of the six network music platform services are calculated (Table 5):

Table 5. Comprehensive score of four popular music services.

	Netease cloud	QQ music	Kuwo Music	Kugou music
Security A	1.413932433	1.280632766	1.318718	1.275872
Reliability B	0.667074742	0.631733095	0.614062	0.625106
Interaction experience C	0.279895619	0.28100761	0.244859	0.259825
Value-added features D	0.207855	0.20208125	0.18476	0.180141
Functionality E	0.98025946	0.98025946	0.917422	0.854585
Guarantee F	0.752364882	0.752364882	0.747315	0.686722
Composite scores	4.301382136	4.128079063	4.027137	3.882251

In terms of the final comprehensive score, the highest score was 4.301382136 for netease Cloud, followed by 4.128079063 for QQ Music and 3.882251 for Kugou Music. Regardless of the comprehensive score, the first three indicators of service evaluation of all online music platforms are the same, namely, security, functionality and assurance. According to the survey score, college students pay more attention to the security, assurance and functionality of music platforms, and netease Cloud has the highest comprehensive score among the four music platforms. In addition, the results of this survey can not only provide users with reference for choosing online music platforms, but also enable online music platforms to know the advantages and disadvantages of their products and clarify the optimization direction, as well as provide indicator system reference for the latter to investigate and evaluate online music platform services.

4 Conclusion

With the rapid development of new media, the digital music industry is thriving, and the online music platform has become a hot topic of attention. College students as the main force of the use of network music platform, their music platform service evaluation for the future improvement of network music platform has a great impact. Therefore, it is of great value to discuss and study the factors of online music platform service that college students are concerned about. It can provide reference for the development of network music platform in the future.

This research establishes a set of objective evaluation index system for online music platform services. Taking Yiyun, QQ Music, Kuwo music and Kugou music as examples, the samples are collected by sending questionnaires to college students. Then the analytic hierarchy Process is used to calculate and analyze the samples, and finally the service scores of each online music platform are obtained.

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