Valuation and Analysis of Online Teaching Platforms in Post-pandemic Era

Yan Wang*, Lijun Nie, and Huawu Jian

***Abstract*—Based on the "Internet + education" concept of the deep integration of information technology and subject education, online flipped classes, MOOC classes and other information-based teaching came into being. This has driven the rapid development of a series of educational APPs and online teaching platforms. However, there are no perfect evaluation systems or evaluation methods to select the online teaching platforms. In view of this, from the perspective of students, this paper mainly extracted four primary indexes and nine secondary indexes by analyzing 1000 students' survey questionnaires. Considering the similar functions of many platforms and each having its own emphasis, and students of different disciplines preferring the different convenient factors, we used the fuzzy comprehensive evaluation method to transform students' qualitative evaluation into quantitative evaluation and designed a scientific and reasonable evaluation system for online platforms. Furthermore, we also filtered out the appropriate online platforms which are preferred by learners of different disciplines. That is, the liberal students prefer the platform of real-time interactive learning and live broadcast, while science students pay more attention to the platform with strong resource and strong feedback, and engineering students are more inclined to the platform with high convenience for teachers and students to share resources. To better carry out online-offline teaching activities in the future, we finally put forward some targeted suggestions according to the data analysis of each platform, so as to realize the intercommunication and sharing of high-quality resources.**

***Index Terms*—Online teaching platform, fuzzy comprehensive evaluation, choice preference.**

I. Introduction

Considering that Internet-education can make educational resources balanced, learning resources global, knowledge extraction methods diversified, knowledge structure three-dimensional, and realize the new ecological education, Chinese Ministry of Education put forward the idea of education informatization [1, 2]. Especially during the spread of COVID-19 pandemic, the policy stipulated that all the teaching or learning activities would be online, thus it's urgent and necessary to change face-to-face teaching or earning to online teaching or learning [3].

As we know, online teaching mainly delivered instructional design principles that are well-designed and learner-centred to provide interactive learning environments for anyone, any place, and at any time [4, 5]. Just using a computer or a mobile phone, we can discuss problems online with people from different majors and the same major, shorten the distance between us, communicate with each other in a relaxed atmosphere to learn from each other and achieve personalized learning. Of course, we also depended on the appropriate online platform, a suitable platform can improve the teaching or learning effect [6, 7]. Although there is rich teaching resource on the online platforms, which could break through the limitations of time and space at the same time, achieving resource sharing, saving education costs, and allowing students and teachers to live, study and work more harmoniously, we cannot ignore its disadvantages. For instance: The instability of the network will hinder each other's communication, which is not conducive to cultivating students' spirit of solidarity and cooperation. Insufficient interaction (first, limited by the platforms, second, some students are unwilling to participate) leads to the lack of interest and attraction in the learning process, it may also lead to congestion or heavy use of some websites, thus learners with poor self-control may have poor learning results; Moreover, researchers have shown the pure practical subjects couldn't be properly studied only through online platforms [6], and so on. In view of the advantages and disadvantages of online platforms, it is necessary to provide some evaluation methods to scientifically select the appropriate platforms. Unfortunately, there are no perfect evaluation systems at present. Since the current research on online teaching is mostly limited to a certain subject [8, 9], or the evaluation of learning effect is also based on some certain platform [10, 11], no matter from the perspective of students or teachers [12, 13], while the evaluation of the advantages and disadvantages of various platforms and the horizontal learning effect are rare.

This paper is structured as follows. In Section II, we analyzed 1000 valid survey questionnaires and extracted the primary and secondary indexes which they were mainly concerned. In Section III, using the fuzzy comprehensive evaluation method, we transformed students' qualitative evaluation into quantitative evaluation and designed a scientific and reasonable evaluation system for online platforms. In Section IV, we put forward some targeted suggestions for online teaching, according to the learning data during the COVID-19 pandemic. Finally, we summarized our results and made some suggestions for future research in Section V.

II. Construction of the Evaluation Index System

For many online platforms, this paper mainly takes six common platforms such as rain classroom, Tencent classroom, Dingding, Lanmoyun class, enterprise wechat and Tencent conference, supernova learning pass as the research

Manuscript received June 23, 2022; revised August 5, 2022; accepted September 12, 2022.

Yan Wang is with College of Mathematics and Systems Science, Guangdong Polytechnic Normal University, Guangzhou, China.

Lijun Nie is with Academy of management, Guangdong Women's Polytechnic College, Guangzhou, China.

Huawu Jian is with No. 1 Primary School of Guangzhou High-Tech Zone, China.

*Correspondence: wangyanshiyuan@163.com

doi: 10.18178/ijiet.2023.13.2.1803

objects. Combined with the characteristics of online platform and the principle of taking students as the main body and teachers as the leading, the evaluation indicators are formulated as shown in Table I:

TABLE I: EVALUATION INDEX

Primary index	Secondary index
Resources	Teachers and students sharing resource
	MOOC resources
Teaching function	Audio and video live broadcasting
	Learning evaluation and feedback (learning-feedback mechanism)
	Reward and punishment mechanism (punch-card mechanism)
Teacher and student interaction	Offline classes interaction
	Online teaching interaction
Learning	Improvement of cooperative learning ability
	Improvement of independent inquiry + problem-solving ability

A. Resource

Resources include two secondary indicators: teachers and students' sharing resources and MOOC resources. The shared resources between teachers and students refer to the teaching resources, such as ppt or videos uploaded by teachers to the platform, and interactive resources such as students uploading homework and participating in discussion, etc. MOOC resources refer to the knowledge related to the course, and the audio & video resources of other universities and institutions. The two indicators of resources are mainly used to evaluate whether the online teaching platform can ensure the sharing and exchange of resources between teachers and students, and give students a platform for autonomous learning-expanding knowledge.

B. Teaching Function

Teaching function includes three secondary indicators: audio and video live broadcasting, learning evaluation and feedback (learning-feedback mechanism), reward and punishment mechanism (punch card mechanism). Among them, audio and video live broadcasting which transmits a large amount of information is closest to the offline teaching. Meanwhile, it is also the premise of direct online interaction between teachers and students. The online platform mainly provides students with exercises before, during and after class, and learning-feedback mechanism gives corresponding feedback to students and teachers on the practice effect and completion. The reward and punishment mechanism refers that teaching platforms provide corresponding means for teachers to test whether students participate in teaching activities orderly and on time, according to the background feedback data of platforms, teachers can well grasp the dynamics of students' learning.

C. Teacher-Student Interaction

Teacher-student interaction includes two secondary indicators: offline classroom interaction and online teaching interaction. Interaction with offline classes refers to the extension function of the teaching platform, that is, the connection between the platform and offline teaching. Online teaching interaction refers to the convenience of communication, discussion and feedback between teachers and students on the platform.

D. Learning

Learning mainly refers to improving students' learning effect and ability, including the improvement of cooperative learning ability and independent inquiry ability. The improvement of cooperative learning ability measures that to what extend the platform is beneficial to students' group cooperative learning and promote their cooperation with others in the teaching activities. The ability of independent inquiry measures the degree to which the platform improves students' ability to learn independently, to explore and solve problems.

III. CONSTRUCTION OF AN APPROPRIATE EVALUATION METHOD

For the evaluation indexes of online teaching, we extract the primary indexes of single factor fuzzy comprehensive evaluation [14], and denote the evaluation factor set by U:

$$\mathrm{U} = \{u_1, u_2, u_3, u_4\} = \{\text{Resource, teaching function, teacher} - \text{student interaction, learning}\}.$$

According to the characteristics of the teaching platforms, the evaluation grades are established as excellent, good, general, and poor. Their corresponding scores are given as 100, 80, 60 and 40 to form the evaluation set

$$V=\{V_1, V_2, V_3, V_4\}=\{excellent, good, general, poor\}.$$

Based on the principle of students as the main body, the questionnaire is designed. Then students of different disciplines should objectively evaluate the importance of secondary indicators. To facilitate the statistical questionnaire, the Likert 5-point scale method is adopted, i.e., the importance is divided into five levels: very important, important, medium, less important, and unimportant [15]. At the same time, they are given corresponding score values of 100, 80, 60, 40 and 20. The weight vectors $w=\{w_1, w_2, w_3, w_4\}$ of different professional characteristics are obtained through weighted statistics.

A. Determine Membership Degree and Fuzzy Relationship Matrix

To determine the membership degree of the evaluation index, we divide students into three categories: engineering, science, and literature. For students of the same category, according to their different preferences for online platforms, we obtain the proportion of preferences for different platforms. In addition, students give corresponding grade recognition to the same platform. Through the weighted average of the preference proportion of the platform and students' grade recognition, the evaluation index is obtained. Finally, the fuzzy relation matrix R of all indexes is obtained

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} \\ r_{21} & r_{22} & r_{23} & r_{24} \\ r_{31} & r_{32} & r_{33} & r_{34} \\ r_{41} & r_{42} & r_{43} & r_{44} \end{bmatrix},$$

where r_{ij} refers to membership value of evaluation index u_i

to comment V_j. Using the fuzzy relation matrix, the comprehensive evaluation vector $B = W * R$ is calculated. Combined comprehensive evaluation vector with the score of the corresponding evaluation, the score of each online platform is finally obtained.

B. Solutions of the Model

In this paper, 1000 valid are collected, including 400 in science, 400 in engineering and 200 in literature. It is hereby declared that the integers in Tables II-V and VI-IX represent the number of people. Through the data of questionnaires, the distribution of students' choices for different platforms is obtained, which is shown in Table II. The index importance level of online platforms which is evaluated by students of different disciplines is also provided. Setting the score of five grades from "very important" to "unimportant" as 100, 80, 60, 40, 20, and using the formula of index weight $= \frac{index\ score}{total\ score}$, we calculate the weight scores of each secondary index (see Tables III, IV and V). Finally, sum the secondary indexes to get the weights of the primary indexes, then we obtain the weight of each index of the online platform, which are shown in Table VI.

TABLE II: DISTRIBUTION OF PLATFORM SELECTION

option	Science (proportion)	Engineering (proportion)	Liberal arts (proportion)
Rain class	80 (20%)	30(7.5%)	20(10%)
Lanmoyun class	60(15%)	20(5%)	10(5%)
Supernova Learning pass	30(7.5%)	70(17.5%)	5(2.5%)
Enterprise wechat &Tencent Conference	60(15%)	80(20%)	85(42.5%)
Dingding	70(17.5%)	70(17.5%)	60(30%)
Tencent classroom	100(25%)	130(32.5%)	20(10%)

From Table VI, it is easy to find the weighted vector W of the primary index. Such as the weight vector of science $w_1 = (0.22\ \ 0.33\ \ 0.22\ \ 0.23)$, the weight vector of engineering $w_2 = (0.23\ \ 0.32\ \ 0.22\ \ 0.23)$, and the weight vector of literature $w_3 = (0.21\ \ 0.33\ \ 0.23\ \ 0.23)$.

TABLE III: EVALUATION OF INDEX IMPORTANCE OF ONLINE PLATFORM BY SCIENCE STUDENTS

Option	Very important	important	Medium level	Less important	unimportant	Weighted score
Teacher&student sharing resources	141(35.3%)	140(35%)	109(27.2%)	8(2 .0%)	2(0.5%)	80.52
MOOC resources	81(20.1%)	109(27.3%)	170(42.5%)	29(7.3%)	11(2.8%)	70.92
Audio and video live broadcasting	98(25%)	131(32.5%)	169(42.5%)	1(0.25%)	1(0.25%)	77.55
Learning evaluation and feedback	129(32.25%)	110(27.5%)	158(39.5%)	1(0.25%)	2(0.5%)	78.15
Reward+punishment mechanism	58(14.5%)	141(35.25%)	141(35.25%)	29(7.25%)	31(7.75%)	68.30
Interaction with offline classes	108(27%)	161(40.25%)	108(27%)	3(0.75%)	20(5%)	77.25
Interaction with online classes	101(25.25%)	181(45.25%)	98(24.5%)	14(3.5%)	6(1.5%)	77.85
cooperative learning ability	100(25%)	200(50%)	90(22.5%)	5(1.25%)	5(1.25%)	79.25
independent inquiry ability	110 (27.5%)	170 (42.5%)	110 (27.5%)	10 (2.5%)	0(0%)	79.0
Total	--	--	--	--	--	688.79

TABLE IV: EVALUATION OF INDEX IMPORTANCE OF ONLINE TEACHING PLATFORM BY ENGINEERING STUDENTS

Option	Very important	important	mediumlevel	Less important	unimportant	weighted score
Teacher & student sharing resources	218(54.5%)	122(30.5%)	21(5.25%)	9(2.25%)	30(7.5%)	84.5
MOOC resources	190(47.5%)	110(27.5%)	50(12.5%)	10(2.5%)	40(10%)	80
Audio and video live broadcasting	209(52.3%)	91(22.75%)	67(16.7%)	3(0.75%)	30(7.5%)	82.32
Learning evaluation and feedback	201(50.3%)	117(29.2%)	45(11.3%)	4(1%)	33(8.2%)	82.48
Reward+punishment mechanism	118(29.5%)	132(33%)	70(17.5%)	19(4.8%)	61(15.2%)	71.36
Interaction with offline classes	160(40%)	129(32.2%)	51(12.75%)	30(7.5%)	30(7.5%)	77.95
Interaction with online classes	166(41.5%)	151(37.75%)	43(10.75%)	10(2.5%)	30(7.5%)	80.65
cooperative learning ability	190(47.5%)	138(34.5%)	40(10%)	2(0.5%)	30(7.5%)	82.8
independent inquiry ability	178(44.5%)	121(30.25%)	60(15%)	10(2.5%)	29(7.25%)	80.15
Total	--	--	--	--	--	722.21

TABLE V: EVALUATION OF INDEX IMPORTANCE OF ONLINE TEACHING PLATFORM BY LITERARY STUDENTS

Option	More important	important	medium level	Less important	unimportant	weighted score
Teacher & student sharing resources	91(45.5%)	39(19.5%)	67(33.5%)	2(1%)	1(0.5%)	81.70
MOOC resources	45(22.5%)	81(40.5%)	67(33.5%)	3(1.5%)	4(2%)	76
Audio and video live broadcasting	78(39%)	67(33.5%)	46(23%)	4(2%)	5(2.5%)	80.9
Learning evaluation and feedback	81(40.5%)	51(25.5%)	67(33.5%)	0(0%)	1(0.5%)	81.1
Reward+punishment mechanism	67(33.5%)	67(33.5%)	60(30%)	3(1.5%)	3(1.5%)	79.2
Interaction with offline classes	68(34%)	109(54.5%)	20(10%)	2(1%)	1(0.5%)	84.1
Interaction with online classes	89(44.5%)	78(39%)	31(15.5%)	1(0.5%)	1(0.5%)	85.35
cooperative learning ability	88(44%)	88(44%)	20(10%)	3(1.5%)	1(0.5%)	85.9
independent inquiry ability	95(47.5%)	67(33.5%)	30(15%)	3(1.5%)	5(2.5%)	84.4
Total	--	--	--	--	--	738.65

TABLE VI: WEIGHT OF EACH INDEX

Primary index	Science	Engineer	Literature
Resources (0.22; 0.23; 0.21)	Teachers and students sharing resources (0.12)	Teachers and students sharing resources (0.12)	Teachers and students sharing resources (0.11)
	MOOC class (0.10)	MOOC class (0.11)	MOOC class (0.10)
Teaching function (0.33; 0.32; 0.33)	Audio and video live broadcasting (0.11)	Audio and video live broadcasting (0.11)	Audio and video live broadcasting (0.11)
	Learning evaluation and feedback (0.11)	Learning evaluation and feedback (0.11)	Learning evaluation and feedback (0.11)
	Reward and punishment mechanism (0.11)	Reward and punishment mechanism (0.10)	Reward and punishment mechanism (0.11)
Student-teacher interaction (0.22; 0.22; 0.23)	Interaction with offline classes (0.11)	Interaction with offline classes (0.11)	Interaction with offline classes (0.11)
	Interaction with online classes (0.11)	Interaction with online classes (0.11)	Interaction with online classes (0.12)
Learning (0.23; 0.22; 0.23)	cooperative learning ability (0.12)	cooperative learning ability (0.11)	cooperative learning ability (0.12)
	Independent inquiry ability (0.11)	Independent inquiry ability (0.11)	Independent inquiry ability (0.11)

TABLE VII: COMPREHENSIVE EVALUATION-INDICATORS OF SCIENCE STUDENTS ON THEIR RESPECTIVE PLATFORMS

Supernova learning pass				
Primary index	excellent	good	general	poor
resources	11	9	10	0
Teaching function	1	10	19	0
Teacher-student interaction	1	1	28	0
learning	1	1	21	8
Dingding				
resources	2	47	21	0
Teaching function	12	48	9	1
Teacher-student interaction	20	31	19	0
learning	11	30	29	0
Lanmoyun class				
resources	12	56	2	0
Teaching function	21	38	1	0
Teacher-student interaction	6	33	20	1
learning	22	31	7	0
Enterprise wechat、Tencent conference				
resources	11	48	1	0
Teaching function	2	47	9	2
Teacher-student interaction	1	21	37	1
learning	1	20	39	0
Tencent classroom				
resources	40	50	9	1
Teaching function	52	28	11	9
Teacher-student interaction	12	69	11	8
learning	41	39	11	9
Rain class				
resources	31	41	8	0
Teaching function	39	40	1	0
Teacher-student interaction	30	31	19	0
learning	28	40	11	1

TABLE VIII: COMPREHENSIVE EVALUATION-INDICATORS OF ENGINEER STUDENTS ON THEIR RESPECTIVE PLATFORM

Supernova learning pass				
Primary index	excellent	good	general	poor
resources	41	28	1	0
Teaching function	38	29	2	1
Teacher-student interaction	36	23	10	1
learning	37	32	1	0
Dingding				
resources	30	38	1	1
Teaching function	21	39	8	2
Teacher-student interaction	23	21	19	7
learning	21	29	20	0
Lanmoyun class				
resources	11	9	0	0
Teaching function	10	10	0	0
Teacher-student interaction	8	10	1	1
learning	9	11	0--	0
Enterprise wechat、Tencent conference				
resources	31	20	19	9
Teaching function	21	31	19	9
Teacher-student interaction	22	32	18	8
learning	30	21	21	8
Tencent classroom				
resources	48	57	16	9
Teaching function	26	75	21	8
Teacher-student interaction	38	46	35	11

learning	16	90	13	11
Rain class				
resources	2	27	1	0
Teaching function	11	19	0	0
Teacher-student interaction	1	28	0	1
learning	9	12	9	0

TABLE IX: COMPREHENSIVE EVALUATION-INDICATORS OF LITERATURE STUDENTS ON THEIR RESPECTIVE PLATFORM

Supernova learning pass				
Primary index	excellent	good	general	poor
resources	2	1	1	1
Teaching function	1	1	2	1
Teacher-student interaction	1	1	1	2
learning	2	2	1	0
Dingding				
resources	40	18	2	0
Teaching function	28	32	0	0
Teacher-student interaction	30	20	9	1
learning	31	28	1	0
Lanmoyun class				
resources	2	8	0	0
Teaching function	1	9	0	0
Teacher-student interaction	3	6	1	0
learning	0	9	0	1
Enterprise wechat, Tencent conference				
resources	1	80	4	0
Teaching function	3	38	41	3
Teacher-student interaction	1	70	14	0
learning	9	72	4	0
Tencent classroom				
resources	1	10	9	0
Teaching function	11	1	8	0
Teacher-student interaction	8	4	7	1
learning	2	10	8	0
Rain class				
resources	2	18	0	0
Teaching function	8	10	2	0
Teacher-student interaction	2	18	0	0
learning	1	19	0	0

TABLE X: SCORES OF CORRESPONDING PLATFORMS OF THREE CATEGORIES

platform	Science score	engineer score	literature score
Tencent classroom	20.25	25.32	7.74
Rain class	16.82	6.12	8.34
Dingding	13.20	14.22	26.84
Lanmoyun class	12.62	4.38	4.06
Enterprise wechat & Tencent Conference	10.84	14.71	26.15
Supernova learning pass	4.95	15.52	1.7

C. Fuzzy Comprehensive Evaluation Results of Each Platform

In questionnaire survey, students are asked to make five grades of evaluation on each index of the selected platform. Using the fuzzy comprehensive evaluation method, we finally get the evaluation scores of six platforms from the perspective of students, which indicate their preferences for each platform. The specific implementation are as follows: students evaluate the indicators of the selected online platforms (see Tables VII-IX) according to the grade recognition numbers, the weighted value $P_1 = \frac{grade\ recognition\ numbers}{total\ numbers}$ of each platform can be obtained. For a given platform, such as Tencent classroom, we consider the weighted value P_1 and the membership degree, then get the fuzzy relation matrix R_1. Accordingly, the comprehensive evaluation vectors about Tencent classroom are

$$B_{science1} = w \cdot R_1 = (0.093 \quad 0.110 \quad 0.025 \quad 0.026),$$
$$B_{engineer1} = (0.078 \quad 0.168 \quad 0.052 \quad 0.024),$$
$$B_{literature1} = (0.031 \quad 0.028 \quad 0.039 \quad 0.001).$$

Assign a corresponding score $\{100,\ 80,\ 60,\ 40\}$ to the comment set

$$V = \{V_1, V_2, V_3, V_4\} = \{excellent, good, general, poor\},$$

we get $L = \{100,\ 80, 60, 40\}$. Noting $S_1 = B_1 ? L^T$, the final score of Tencent classroom is obtained

$$S_{science1} = 20.25,\ \ S_{engineer1} = 25.31,\ S_{literature1} = 7.74.$$

In the same way, we get the final scores of the other five online platforms which are supernova learning pass, Dingding, Lanmoyun class, enterprise wechat and Tencent conference, and Rain class

$S_{science2} = 4.95$, $S_{engineer2} = 15.52$, $S_{literature2} = 1.7$,
$S_{science3} = 13.20$, $S_{engineer3} = 14.2$, $S_{literature3} = 26.84$,
$S_{science4} = 12.62$, $S_{engineer4} = 4.38$, $S_{literatur4} = 4.06$,
$S_{science5} = 10.84$, $S_{engineer5} = 14.71$, $S_{literatur5} = 26.15$,
$S_{science6} = 16.82$, $S_{engineer6} = 6.12$, $S_{literatur6} = 8.34$.

D. Professional Analysis

1) Science

Since science is highly abstract and logical, and knowledge points are closely related, there are certain difficulties in learning process. From the indicator weights, we find that the indicators which students in science preferred are the teachers and students' sharing resources, learning evaluation and feedback, as well as cooperative learning and independent inquiry ability. However, they pay less attention to audio and video live broadcasting, MOOC resources and so on.

What's more, noting the scores of each platform in Table X, we find that science students like Tencent classroom best with 20.25 points, there is 15.3 points different between the lowest supernova learning pass and Tencent classroom. Rain class, Dingding, Lanmoyun class, and the enterprise wechat and Tencent conference are ranked in turn. From the difference of scores, we find that science students prefer Tencent classroom and rain class, which not only provide sharing resources to teachers and students, but also can play all the resources repeatedly. However, supernova learning pass, as a learning platform for online courses, is less applied in science courses with more pure theories. At the same time, it does not coincide with indicators valued by students, and the score is relatively low compared with other platforms.

2) Engineer

The highest weight of engineering index is the sharing resources between teachers and students, while the scores of other indicators have little difference. Compared with science, engineering students are more inclined to practical application, that is, the ability of practical operation. Engineer learners require a lot of experiments to produce a large amount of data and a large amount of analysis. The operation and application of the machine, the precautions and the processes of experiments are all their learning resources. However, some of this knowledge is lacking in textbooks, teachers-students sharing resources can just make up for these defects. Sharing resources are not only convenient for students to discuss and communicate with teachers, but also teachers can share a large of experimental tools and data to provide some demonstration for students.

According to Table X, engineer students also prefer Tencent classroom. There is little difference in the evaluation of supernova learning pass, Dingding, enterprise wechat and Tencent conference, but express lower preference and lower evaluation of rain classroom, Lanmoyun class and other platforms combining activities or offline classes. As the previous analysis, Tencent classroom is a more comprehensive platform. Its resource and resource sharing meet the needs of engineering students. As a representative platform for online learning, supernova learning pass allows students to independently learn the frontier of knowledge. Therefore, these two platforms are relatively preferred by engineer students. Rain class and Lanmoyun class do not provide a platform for engineering students to study independently and extra-curricular learning, so the corresponding scores are low.

3) Literature

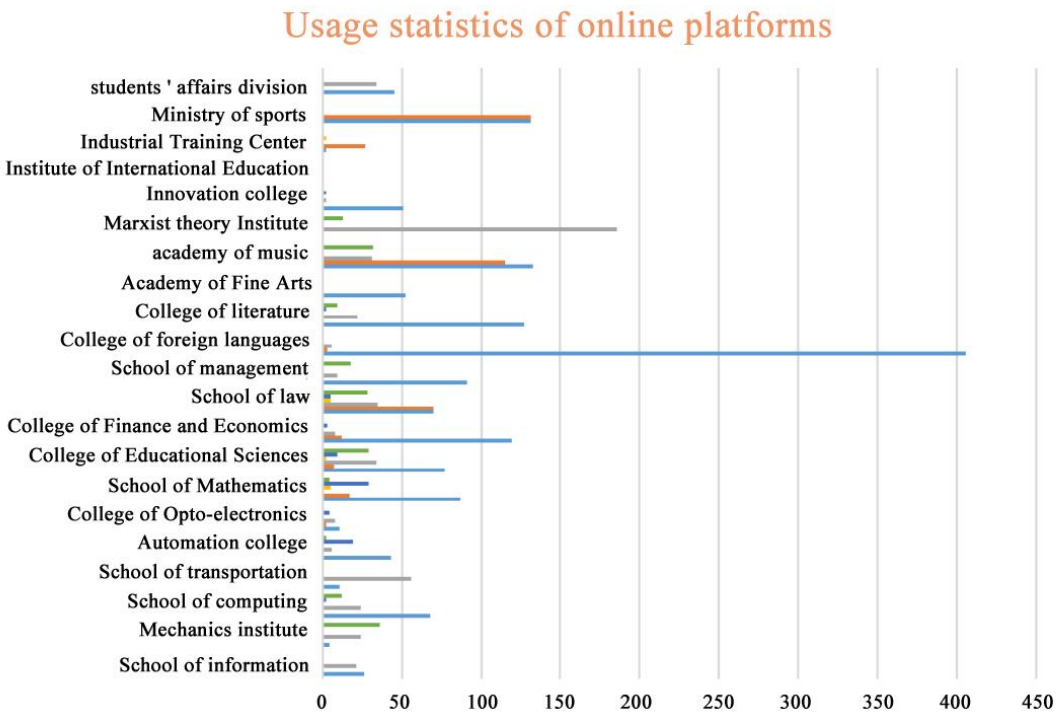
From the index weights of literature, we find that literature students pay more attention to learning function of the platform, i.e., the cooperative learning and independent inquiry ability, and their preference for other indicators is not high. For a subject with language as its tool, literature has artistic characteristics, and the simplest form of language is face-to-face communication and expression, which emphasizes the immediacy to some extent. Literature students need to read a large of literary works and history to shape their own expression characteristics. The accumulation of literature indicates that literature students need a lot of learning, and the most direct way to use language is immediate expression, so literature students prefer immediacy and learning platform. Compared with science, literature does not have abstract theoretical knowledge, and compared with engineering, it does not have newer and faster technology and a large of experimental operations, thus literature students' requirements for MOOC class and sharing resources are not particularly high. Literature is more concern about the accumulation of their knowledge and the improvement of their ability, so they pay more attention to the learning and immediacy of the platform.

From Table X, we find that literature students focus on enterprise wechat, Tencent conference and Dingding. The evaluation scores of traditional online platforms are students' mutual learning and communication between teachers and students. Although the communicating function of enterprise wechat and Tencent conference is not strong, literature students do not have high requirements for resource sharing. The real-time live broadcasting is just beneficial to communicate and discuss in real-time. Therefore, compared with the traditional platforms that prefer resources, enterprise wechat and Tencent conferences with strong instant and learning functions can well meet their needs and are highly praised. From scores of corresponding platforms of three categories (see Table X), Tencent classroom with relatively high graded by science and engineering students is relatively low in literature students' opinion. Because Tencent classroom is more comprehensive and perfect, it not only has extra-curricular learning resources, but also provides space for teachers and students to upload resources. It retains some online live broadcasting, moreover, it is also more convenient to login Tencent classroom by QQ and wechat. In short, science and engineering students prefer teachers-students sharing resources, learning evaluation and feedback, and finally the ability of independent learning and cooperative learning. They do not have high requirements for the live broadcasting, MOOC resources, and online and offline interaction. However, literature students prefer platforms which have strong real-time live broadcasting, such as: Dingding, enterprise wechat and Tencent conferences and so on. Considering their emphasis on index learning of the platform, we find that literature students are more inclined to the online platforms with live broadcasting in the independent learning or cooperative learning process, they do not have high requirement for sharing resources, so they don't prefer the traditional platform with online and offline

function. In short, from the preference for platforms, literature students prefer platforms with real-time interactive learning and live broadcasting, while science and engineering students prefer online platforms with traditional resources or MOOC resource.

E. Statistics on the Use of Online Platforms by Different Colleges of the University

From the using data of online platforms in each college [16], Fig. 1 shows that teachers of literature, such as school of media, academies of music and foreign languages and so on, mainly select Dingding (QQ group, wechat group) and other platforms with strong real-time live broadcasting. It is consistent with the results of our previous analysis, i.e., literature students prefer online platforms such as Dingding, and enterprise wechat and Tencent Conference. In the school of electronics and information, the school of computer science and the school of Optoelectronic Engiineering, teachers are concentrated on supernova learning pass and Dingding platforms. It is also more consistent with the types of platforms we analyzed from the perspective of engineer students.



	School of information	Mechanics institute	School of computing	School of transportation	Automation college	College of Opto-electronics	School of Mathematics	College of Educational Sciences	College of Finance and Economics	School of law	School of management	College of foreign languages	College of literature	Academy of Fine Arts	Academy of music	Marxist theory Institute	Innovation college	Institute of International Education	Industrial Training Center	Ministry of sports	Students ' affairs division
Others(Numbers)	0	36	12	0	1	0	4	29	0	28	18	0	9	0	32	13	0	0	0		0
Lanmoyun class(Numbers)	0		1	0	19	4	29	9	3	5	0	0	1	0	0	0	1	0	0		0
Rain class(Numbers)	0		0	0	0	0	5	1	0	5	0	0	0	0	0	0	0	0	2		0
Supernova learning pass	21	24	24	56	6	8	0	34	8	35	9	6	22	0	31	186	2	0	0		34
Tencent Conference(Numbers)	0		0	0	0	2	17	7	12	70	0	3	0	0	115	0	0	0	27	131	0
Dingding(Numbers)	26	4	68	11	43	11	87	77	119	70	91	406	127	52	133	0	51	0	2	131	45

Fig. 1. Usage statistics of teachers' choice of online platforms during the COVID-19 pandemic.

On the selection of online platforms for literature and engineer, teachers and students have the same preference. However, In the school of mathematics and systems science represented by the discipline of science, students prefer Tencent classroom and rain classroom, while most of teachers choose Lanmoyun and Dingding platforms. In view of this situation, teachers can appropriately communicate with students and choose a suitable platform with little difference between them.

IV. Teaching Suggestions

Online teaching has unique advantages and limitations compared with traditional classroom. We should pay attention to the following issues when choosing the online platform:

A. Selection of Online Platform

For a variety of online platforms, a suitable platform can improve the teaching effect. According to the theoretical results: students of different disciplines have different preferences for platform's functions and their own advantages. Therefore, we should combine the function and advantages of the platform with students' preference index when selecting them.

B. Integration of Online Platform and Offline Classroom

Compared with the traditional classroom, online teaching has the advantages of unlimited time and space, but it also has its own disadvantages. For example, the interaction between teachers and students is not strong, the learning feedback of students is delayed, the enthusiasm of students participate in the classroom is not high and so on. Online teaching highlights the concept of taking students as the main body to some extent, but we can't ignore the guiding role of teachers and face-to-face interaction between teachers and students. Therefore, when carrying out mixed classroom teaching, we should fully combine the online platform with the offline classroom, give full play to their respective advantages, and make teaching more diversified.

C. Improve Students' Ability of Independent Learning and Cooperative Learning

Flipped classroom has higher requirements for students' ability of independent learning and cooperative learning, however, online teaching activities can't be directly and conveniently regulated and managed by teachers like traditional offline classroom. Online platform provides students with a good medium for independent learning and gives them the initiative to learn. In the process of flipping classroom, teachers should fully play the role of "guide" and consciously improve their awareness and habits in this regard.

D. Pay Attention to Students' Participation

Teaching is a bilateral activity between teachers and students. In fact, students' participation in the classroom will directly affect the teaching effect of this class. Compared with the traditional classroom, in the long-term online teaching, students' participation and learning enthusiasm are often relatively low. How to create a good learning atmosphere, stimulate students' thirst for knowledge and participation, and maximize classroom effectiveness is the key issue that online platforms need to pay attention to. To solve these problems, teachers can master the situation of students' participation and increase the frequency of students' participation through the background data. Furtherly, they can also adopt various forms of online activities to encourage actively participating students. For some passive students, can carry out group activities and select active students as team leaders to help them. Finally, through the final group evaluation, a benign competitive atmosphere is formed so that students can imperceptibly participate in classroom learning.

E. Pay Attention to the Interaction between Teachers and Student

Teaching knowledge should be an interactive process. In online teaching process, students are faced with mobile phones or computers, they lack the learning atmosphere of offline classroom and appear monotonous, which is not beneficial to students' learning enthusiasm. Therefore, teachers should pay attention to the interaction between teachers and students, create a positive and active atmosphere and let students invest more emotion in learning.

V. Conclusion

In this paper, we constructed a scientific evaluation system of the online platforms, taking students' problem-solving ability and their using information sharing platforms for cooperative learning or independent inquiry as the priority indicators. Firstly, we analyzed 1000 valid survey questionnaires of the students from different disciplines, extracted four primary indexes and nine secondary indexes which they were mainly concerned. Then using the fuzzy comprehensive evaluation method, we filtered out the online platform types preferred by learners of different disciplines. That is, the liberal students prefer the platform of real-time interactive learning and live broadcast, while science students pay more attention to the platform with strong resource and strong feedback, and engineering students are more inclined to the platform with high convenience for teachers and students to share resources. Furtherly, we compared the matching between teachers and students of some university in selecting online platforms during the COVID-19 pandemic, and found that in literature and engineer departments, teachers and students have the same preference. However, in the school of mathematics and systems science represented by the discipline of science, students preferred Tencent classroom and rain classroom, while most of teachers chose other platforms. Therefore, the evaluation system proposed in this paper is very useful to select appropriate online platforms, whether for teachers or students.

To better use of the online platforms in the future, we should avoid insufficient teacher-student interaction, lagging students' learning feedback, and low enthusiasm of students' participation. Meanwhile, we need to innovate the way of teaching and learning, broaden the breadth and depth of students' cognition, and improve their independent inquiry ability, and so on.

Acknowledgment

This study was supported by collaborative education project of Higher Education Department, Ministry of education (No. 202101299022), and a Natural Science research project by Guangdong Provincial NSF(Grant No. 2018A030313546).

Conflict of Interest

The authors declare no conflict of interest.

Author Contribution

Yan WANG and H. W. Jian jointly conducted the research, analyzed the data and wrote the paper. L. J. Nie was responsible for data collection and assisted in data analysis and formatted the manuscript. All three authors have read and agreed with the published version of the manuscript.

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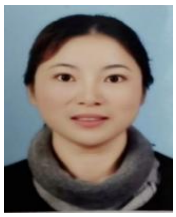
Yan Wang received the doctor degree in applied mathematics from ShangHai University in 2014. This author is working and teaching at Guangdong Polytechnic Normal University, majors in dynamics of complex systems, has published more than ten papers in Journals of Physica A: Statistical Mechanics and its Applications, Physics letter A, Nonlinear Analysis, International Journal of Modern Physics C, Communications in Theoretical Physic, etc.



Lijun Nie graduated from Guangdong University of Technology, majors in human resource management, marketing and higher education research. She won the second award of Teacher Ability Competition in National Vocational College, and the first prize in the Guangdong Vocational College Teaching Design Competition. She has written two textbooks and published 9 papers.

Huawu Jian received undergraduate degree in science from Guangdong Polytechnic Normal University in 2016. This author is teaching Mathematics at No. 1 primary school of Guangzhou high-tech Zone, he is conscientious and responsible for students and highly praised by teachers and students.