Data Analysis on Factors Influencing Satisfaction of Interactive Live Teaching

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Abstract: Effective online live interaction is a key factor in enhancing the quality of online live teaching. To investigate the relationship between factors influencing online live interaction and satisfaction, a questionnaire survey was conducted in this study. The survey targeted first-year students at a local college, assessing their satisfaction with live broadcasts of two foundational courses: "College English" and "College Physics". Analysis was conducted using R programming language, revealing that regardless of the discipline, the mode, means, content, frequency, and depth of interaction significantly affect the satisfaction with online live interaction in foundational courses. When considering the characteristics of each discipline, the influence of these factors on live satisfaction varies in strength. There are correlations among the interactive factors. There is a strong positive correlation between interaction depth and frequency, and there is also a strong correlation between interaction means and content. Finally, conclusions were summarized, and corresponding strategies and recommendations were proposed.

1. Introduction

Classroom teacher-student interaction refers to various forms and degrees of interaction and influence between teachers and students in the classroom. Active student participation and effective interaction between teachers and students are prerequisites for ensuring the effectiveness of online teaching. They are important means to improve students' autonomous learning ability and construct their own learning systems [1]. They are also key factors in enhancing the quality of online teaching [2].

During the COVID-19 pandemic, various schools relied on online platforms such as DingTalk, Tencent Classroom, QQ, and Rain Classroom to conduct live streaming teaching, which became the primary method of online education [3-5]. Literature 6 elaborates on the connotation and extension of online teaching interaction, summarizes the "Four Characteristics" principles of online teaching interaction (effectiveness, timeliness, adequacy, diversity), and provides basic methods to improve interaction effectiveness from four dimensions: interaction breadth, interaction depth, interaction intensity, and interaction persistence.

The author obtained a large amount of data on interactive live teaching through survey questionnaires and utilized R programming language to conduct in-depth analysis on the characteristics and patterns embedded in the data. The aim is to explore the correlation between interactive factors and the effectiveness of live teaching, and based on this, propose interactive strategies to enhance the effectiveness of online live teaching.

2. Research design

2.1. Factors influencing satisfaction with live interaction

Common interactive methods in current online live teaching include pre-class attendance check-ins, in-class group discussions, live roll calls, quiz card tests, raising hands to answer questions, as well as post-class communication through WeChat or QQ private messages [6]. Practice has shown

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that different interaction methods and different interaction content yield different interaction effects. The factors influencing classroom interaction effects can generally be categorized into teacher factors, student factors, teaching factors, and environmental factors [7]. Teacher factors refer to the personal attributes of teachers, including personality, qualities, teaching abilities, teaching attitudes, and teaching methods. Student factors refer to the personal attributes of students, including personality, learning attitudes, learning methods, and learning habits. Teaching factors refer to the directly related factors of teaching methods, teaching media, teaching content, and assessment methods. Environmental factors refer to the hardware used to support teaching, such as teaching environment, teaching technology means, and teaching facilities and equipment.

Through the analysis of teaching factors in online live interaction, these can be further refined into five influencing factors: interaction means, interaction content, interaction mode, interaction frequency, and interaction depth.

2.2. Questionnaire survey

Based on the assumptions regarding the five factors influencing satisfaction with online live teaching mentioned above, this study conducted a survey on the satisfaction with live streaming of two foundational courses: College English and College Physics, using an online questionnaire survey. The questionnaire survey is divided into three parts: the first part gathers basic information such as the student's college and online learning courses, the second part focuses on the satisfaction with current live streaming teaching, and the third part involves an investigation regarding interactive factors. After examination, the reliability of each item in the questionnaire is above 0.7 (Cronbach's Alpha coefficient is 0.913), indicating that the questionnaire has high reliability. The subjects of this study are first-year students at a certain university. A total of 3120 questionnaires were distributed, and 3120 valid questionnaires were collected, resulting in a 100% response rate.

3. Findings

This study employs the data statistical analysis method using the R programming language and conducts data analysis at three levels. Firstly, without considering the discipline, the study analyzes the relationship between each interactive factor and satisfaction with live streaming. The independent variables are interaction mode, interaction means, interaction content, interaction frequency, and interaction depth, while the dependent variable is satisfaction with live streaming. Secondly, the study analyses the correlation between each interactive factor and satisfaction with live streaming according to the discipline.

3.1. Comprehensive study of influencing factors without distinguishing disciplines

Preliminary research results indicate that, without considering disciplinary characteristics, the five factors of interaction mode, interaction means, interaction content, interaction frequency, and interaction depth all have significant impacts on satisfaction with live streaming. If we rank them in order of impact, the order would be: interaction frequency > interaction mode > interaction depth > interaction means > interaction content. Among them, interaction frequency has the most significant impact on satisfaction with live streaming, while interaction content has the weakest impact. The analysis results are as follows.

3.1.1. Analysis of variance for each factor and satisfaction with live streaming

Table 1 Analysis of variance for each factor

	Degrees of freedom	square sum	mean square	F-value	P-value
interaction frequency	4	33.4	8.354	20.54	<2e-16 ***
interaction mode	2	25.8	12.910	31.57	2.67e-14 ***
interaction depth	3	22.3	7.425	18.1	1.21e-11 ***
interaction means	4	19.1	4.785	11.63	2.24e-09 ***
interaction content	3	10.3	3.439	8.305	1.68e-05 ***

As shown in Table 1, it can be observed that all five interaction factors have a significant impact on satisfaction with online teaching live streaming ($p < 0.05$). Among them, interaction frequency has the most significant impact on satisfaction with live streaming, followed by interaction mode, interaction depth, interaction means, and lastly, interaction content.

3.1.2. The correlation coefficients between each factor and satisfaction with live streaming

To further investigate the impact of each factor on satisfaction with live streaming, Tables 2 to 5 display the correlation coefficient results for each factor, indicating the magnitude of the association between individual factors and satisfaction with live streaming. Regarding the association between interaction frequency and satisfaction with live streaming, according to the results shown in Table 2, the impact of interaction frequency of 7 times or more on satisfaction with live streaming is the most significant, followed by 5-6 times.

Table 2 Correlation coefficients for interaction frequency

	observed value	standard error	T-value	P-value
(intercept)	4.45333	0.05208	85.515	< 2e-16 ***
1-2 times	0.03345	0.05725	0.584	0.559043
3-4 times	0.10209	0.05654	1.806	0.071078
5-6 times	0.19818	0.05994	3.306	0.000956 ***
More than 7 times	0.28439	0.05601	5.077	4.05e-07 ***

Regarding the association between interaction mode and satisfaction with live streaming, according to the results shown in Table 3, teacher-student interaction has the greatest impact on satisfaction with live streaming, followed by student-student interaction.

Table 3 Correlation coefficients for interaction mode

	observed value	standard error	T-value	P-value
(intercept)	4.45542	0.03139	141.927	< 2e-16 ***
student-student interaction	-0.09940	0.05592	-1.778	0.0756
teacher-student interaction	0.19273	0.03388	5.689	1.4e-08 ***

Regarding interaction means, as shown in Table 4, the means of voice interaction have the most significant impact on satisfaction with live streaming, followed by video interaction means. In terms of the magnitude of influence, the order of several interaction means is as follows: voice interaction > video interaction > image interaction > text interaction > quiz card interaction.

Table 4 Correlation coefficients for interaction means

	observed value	standard error	T-value	P-value
(intercept)	4.52620	0.02997	151.025	< 2e-16 ***
image interaction	-0.10953	0.09731	-1.126	0.2604
text interaction	0.02111	0.03512	0.601	0.5479
video interaction	0.10893	0.04783	2.277	0.0228 *
voice interaction	0.17535	0.03567	4.915	9.31e-07 ***

Finally, regarding interaction content, as shown in Table 5, complex open-ended questions have the most significant impact on satisfaction with live streaming, followed by simple open-ended questions. In terms of the magnitude of influence, the order is as follows: complex open-ended questions > simple open-ended questions > simple closed questions > complex closed questions.

Table 5 Correlation coefficients for interaction content

	observed value	standard error	T-value	P-value
(intercept)	4.55690	0.01965	231.863	< 2e-16 ***
complex open-ended questions	0.22217	0.04462	4.979	6.74e-07 ***
simple closed questions	0.05179	0.03419	1.515	0.1299
simple open-ended questions	0.05114	0.02670	1.916	0.0555

3.2. Study on influencing factors with distinction among disciplines

To delve deeper into the correlation between satisfaction with interdisciplinary interactions and influencing factors, the author conducted further research and found that, considering the characteristics of each discipline, the five aforementioned influencing factors exhibited varying degrees of correlation with satisfaction levels of live broadcasts in respective courses. The analysis results and underlying reasons for the two courses—college English and college physics—are discussed in detail in the following order.

3.2.1. Research on factors influencing satisfaction with college English

Firstly, the impact magnitude of these five factors on the satisfaction with live broadcasts of college English courses is as follows: interaction frequency > interaction depth > interaction mode > interaction content > interaction means. The results are as shown in Table 7.

Table 7 Analysis of variance of influencing factors in College English

	degrees of freedom	square sum	mean square	F-value	P-value
interaction frequency	4	11.1	2.7736	6.787	2.19e-05 ***
interaction depth	3	5.7	1.893	4.572	0.00346 **
interaction mode	2	3.8	1.8797	4.522	0.0111 *
interaction content	3	3.7	1.2257	2.945	0.0321 *
interaction means	4	3.8	0.9620	2.31	0.0562 .

From this, it can be seen that, consistent with the comprehensive analysis, interaction frequency remains the most significant factor influencing satisfaction with live broadcasts. Slightly different is that interaction depth ranks second, indicating that students consider the depth of interaction in college English classrooms to be quite important, in addition to the frequency of interaction. The quality of interaction between students and teachers also affects students' satisfaction with this course's live broadcast. Furthermore, unlike the comprehensive analysis, in terms of interaction content, the impact of simple closed-ended questions on the satisfaction with live broadcasts of college English courses is most pronounced, as shown in Table 8. Delving into the underlying reasons, perhaps it is because English, being students' second language, answering simple yes or no questions might generate easier interaction for students, resulting in higher student engagement and a broader coverage of students. However, data from the survey questionnaire shows that students' favorite type of interaction content is simple open-ended questions. This indicates that students are increasingly favoring interactive questions that do not have standard answers and provoke thought.

Table 8 Correlation coefficients of interaction content in College English

	observed value	standard error	T-value	P-value
(intercept)	4.54980	0.04072	111.733	< 2e-16 ***
complex open-ended questions	0.15608	0.08096	1.928	0.05417 .
simple closed questions	0.18743	0.06853	2.735	0.00636 **
simple open-ended questions	0.08303	0.05057	1.642	0.10094

Different from the comprehensive analysis, there is also variation in interactive methods. Data analysis indicates that interactive methods have no significant impact on satisfaction with live broadcasts of college English courses. This suggests that no particular interactive method has a notably significant effect on satisfaction with the live broadcast. See analysis results in Table 9. In conjunction with the characteristics of the English discipline, this may be due to the diverse interactive methods employed in college English courses. Each class may cover various interactive methods such as oral interaction, video interaction, image interaction, text interaction, and quiz card interaction. Therefore, no single method has a special impact on satisfaction because of the subject's characteristics. Considering the survey data, students' preferred interactive method is oral interaction. This could be attributed to the fact that oral interaction can provide a more genuine sense of classroom participation, thus appealing more to students.

Table 9 Correlation coefficients of interactive methods in College English

	observed value	standard error	T-value	P-value
(intercept)	4.65079	0.08130	57.202	< 2e-16 ***
image interaction	-0.31746	0.20326	-1.562	0.119
text interaction	-0.09563	0.08996	-1.063	0.288
video interaction	0.04486	0.10115	0.443	0.658
voice interaction	0.01802	0.08664	0.208	0.835

3.2.2. Research on factors influencing satisfaction in College Physics

Unlike college English courses, the impact of these five factors on satisfaction with live broadcasts of college physics courses is in the following order: interaction mode > interactive methods > interaction frequency > interaction depth > interaction content. The results are shown in Table 10.

Table 10 Analysis of variance for factors influencing College Physics

	degrees of freedom	square sum	mean square	F-value	P-value
interaction mode	2	19.5	9.736	21.81	5.09e-10 ***
interaction means	4	16.3	4.068	9.04	3.46e-07 ***
interaction frequency	4	14.7	3.676	8.144	1.79e-06 ***
interaction depth	3	13.1	4.355	9.625	2.82e-06 ***
interaction content	3	4.5	1.508	3.278	0.0204 *

Unlike the comprehensive analysis, interaction mode is the most significant factor influencing satisfaction with live broadcasts of college physics courses. Among them, teacher-student interaction is the interaction mode that most affects student participation satisfaction in the classroom, which is consistent with the results of the comprehensive analysis. Ranked second is interactive methods, indicating that the choice of interactive methods plays a crucial role in the effectiveness of live broadcasts for college physics courses. Combining the survey questionnaire data, students prefer oral interaction the most, followed by text interaction. Unlike college English courses, in terms of interaction content, the impact of complex open-ended questions on satisfaction with live broadcasts is most pronounced. The analysis results are shown in Table 11. Later, through interviews with students and teachers, the author learned that, on the one hand, there are fewer simple closed-ended questions between students and teachers in college physics classrooms. On the other hand, what needs to be addressed in class are mostly slightly complex open-ended questions related to students' majors. Participating in interactive discussions that require deeper thinking enhances students' classroom experience.

Table 11 Correlation coefficients of interaction content in College Physics

	observed value	standard error	T-value	P-value
(intercept)	4.515011	0.032595	138.517	< 2e-16 ***
complex open-ended questions	0.244025	0.081272	3.003	0.00274 **
simple closed questions	0.000544	0.055741	0.010	0.99221
simple open-ended questions	0.050978	0.047224	1.080	0.28059

4. Conclusion

In the absence of considering disciplinary characteristics, compared to the other four factors, interaction frequency has the greatest impact on live broadcasting satisfaction, with the highest satisfaction observed for live broadcasts with an interaction frequency of seven times or more. Following this, teacher-student interaction has the greatest impact on live broadcasting satisfaction, with over 70% of students believing that the best interaction mode is between students and teachers. In terms of interaction depth, the greatest impact on live broadcasting satisfaction is observed when the average interaction duration exceeds 4 minutes. However, the majority of students only engage

in 1-2 minutes of interaction per class. In terms of interaction means, the most commonly used interaction method currently is text interaction. However, the interaction method that most impacts live broadcasting satisfaction is voice interaction, and the majority of students also agree that the best interaction method is voice interaction. In terms of interaction content, complex open-ended problems have the most significant impact on live broadcasting satisfaction. However, students believe that the best interaction content is simple open-ended problems.

When considering disciplinary characteristics, for the college English course, interaction frequency remains the most significant factor affecting live broadcasting satisfaction, followed by interaction depth. In terms of interaction means, none of the interaction methods have a significant impact on live broadcasting satisfaction. As for interaction content, simple closed-ended questions have the greatest impact on satisfaction, while students prefer simple open-ended questions the most. For the college physics course, the most significant factor affecting live broadcasting satisfaction is the interaction mode, with teacher-student interaction being the most favored. Following this is the interaction means, with students preferring voice interaction the most. In terms of interaction content, complex open-ended problems have the greatest impact on live broadcasting satisfaction. In engineering mathematics courses, interaction frequency is the most significant factor influencing live broadcasting satisfaction, which is consistent with college English courses. Regarding interaction content, similar to college physics, complex open-ended problems and voice interaction have the most significant impact on live broadcasting satisfaction.

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