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ORIGINAL RESEARCH

Analysis of Online Teaching Environment and Satisfaction in the Context of the Epidemic

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Abstract

Many educational institutions have adopted e-learning under the COVID-19 pandemic to maintain school teaching activities. Most teachers were encouraged to use online instruction in early February 2020. Thus, online education has become a sensitive topic regarding whether online learning fits students' learning habits and what factors can affect the quality of online teaching. This study examined the online learning of elementary school students in the epidemic context and the factors affecting their satisfaction with online learning. 499 elementary school students and 167 teachers were surveyed and it was found that online teaching and learning activities were conducted orderly. Teachers mainly used the live tutoring, and independent learning model, support services for online learning performed well. A multiple regression model was used to analyze the degree of influence of the teaching objectives, teaching methods and activities of teachers, teaching support, and learning efficiency on student satisfaction in online courses. The results showed that all four dimensions had a positive effect on happiness. Based on the analysis of the data obtained from the survey, coping strategies to improve the quality of online teaching in the post-epidemic period are proposed at the social level, teacher level, and school level. The social group should pay attention to the construction of educational resources, schools should strengthen teachers' professional development, and teachers should take the initiative to motivate students and give timely feedback to provide references for relevant decisions and related research in the post-epidemic era.

Keywords Online learning · Strategy · Multiple regression · Classes Suspended but Learning Continues

Introduction

With the development of education informatization, the popularity of online education has risen, and online education has developed rapidly during the epidemic. Countries began to take action to promote the development of online education. As a result, the global expansion of online education has shown explosive growth. China was the first to respond. With the Ministry of Education's "Classes Suspended but Learning Continues" initiative, schools at all levels across the country reacted quickly to the call to use online platforms to build cloud classes and organize online learning for students at home.

Background

The epidemic's arrival has made online education critical, but its problems persist in the actual application process. Since many teachers have no experience in online instruction, lack the theoretical foundation of online education and cannot design online courses, Most of them treat online classes as offline classes directly, which can make the course design unreasonable and the teaching effect not optimistic [1]. In terms of hardware, there is also an unbalanced development between regions, urban and rural areas, and interschools in China. The differences in support and security of online education have led to uneven teaching results. Second, in the "Classes Suspended but Learning Continues" phase, since the essential classroom hardware and equipment mainly comes from the home, the difference between students' home capital also affects the effect of online learning

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at home, making the imbalance of online education aggravated [2]. The imbalance in online education-exacerbate dated.

Literature Review

At present, from the relevant research literature, scholars have investigated and studied the current situation of online learning mainly in the aspects of learning environment, learning process, network equipment, family participation, and learning effect. Ji Yi based on many theoretical research and events at home and abroad, independently designed a questionnaire with 21 measurement variables, mainly involving four parts, the first part is the satisfaction survey of teaching equipment, mainly including the survey of platform construction, network situation, teaching resources, teaching places, etc.; the second part is the satisfaction survey of teaching process, mainly including. The second part is the satisfaction survey of teaching process, which mainly includes the survey of teachers' level, teaching assistants' work, quality of teaching videos, homework quantity and difficulty of homework, group members' matching, teaching time allocation, length of teaching videos, etc.; the third part is the satisfaction survey of teaching effect, which mainly includes the classroom atmosphere, group activeness, etc.; the fourth part is the survey of overall satisfaction, which includes the favorability of flipped classroom, the recognition of flipped classroom and some issues compared with The fourth part of the survey is about the overall satisfaction, including the favorability of the flipped classroom, the recognition of the flipped classroom, and some issues compared with the traditional classroom [3]. Guoliang Hu and Meichu Huang designed a survey on four dimensions: satisfaction with teaching environment, satisfaction with teaching process, satisfaction with teaching effect, and overall satisfaction [4]. Wang Hao and Han Yongfang focused on the dimensions of satisfaction with learning environment, satisfaction with teaching design, satisfaction with learning outside the classroom, satisfaction with classroom learning, and satisfaction with learning outcomes [5]. Other scholars draw on the PISA framework for measuring learning engagement, which is developed in five dimensions: behavioral engagement, psychological engagement, individual adaptation, teaching organization, and family support. Behavioral engagement includes online learning tool selection, online learning time, and online learning habits; psychological engagement includes the degree of liking online learning and satisfaction with online learning; individual adaptation includes students' online learning conscientiousness situation and network use preference; teaching organization includes course design situation, class load situation, and teacher–student interaction situation; family support includes family resource support, family care support, and family parent–child communication, etc., and explored the inter-school differences in students' online learning participation during the epidemic and their influencing factors [6].

Online teaching satisfaction surveys aim to assess students' and teachers' perceptions and experiences of online learning. Many studies have found that while students generally enjoy the flexibility and convenience of online learning, they often experience challenges such as feeling isolated and disconnected from their peers and instructors, and a lack of motivation. Additionally, students often report a lack of interaction and engagement with the course material, which can lead to decreased learning outcomes. Teachers, on the other hand, often face challenges related to technology and infrastructure, such as difficulties with online tools and a lack of training in online pedagogy. They also report feeling overwhelmed by the increased workload and lack of face-to-face interaction with their students. In order to improve online teaching, researchers have recommended several strategies, such as providing more training and support for teachers to effectively integrate technology into their teaching; Encouraging more interaction and engagement between students and teachers, as well as among students themselves. These studies clearly point out the dilemma of online teaching, but also in this particular period, teachers mainly take the teaching mode, teaching evaluation, etc. has not been clear, the main factors affecting online teaching and learning there are still with the exploration.

Online education in the context of the epidemic has three main characteristics: the large scale involved, the long duration, and the heavy teaching tasks. This survey can provide accurate data to inform relevant decisions and research in the post- epidemic era. Various government and social functions can offer better online teaching and learning services and provide strong support for schools to carry out health education and teaching activities in the post-epidemic era.

Methods

Participants

The respondents of this study were the students and teachers of Primary School H in Nanpi County, Hebei Province. Convenience sampling was used. 499 elementary school students and 167 teachers were surveyed. The respondents were students in grades 1–6 in Primary School H in Nanpi County, Hebei Province, of which 25.45% were in grade 1, 17.64% in grade 2, 15.03% in grade 3, 13.43% in grade 4, 16.43% in grade 5, and 12.02% in grade 6. The teachers were involved in language, mathematics, English major and audio, physical and aesthetic minor subjects, with significant subject teachers predominating.

Measures

Based on the online teaching implementation model proposed by Darab and Montazert in 2011 and concerning Feng, Y.-H.'s Online Teaching Quality Satisfaction Scale [7], the framework and dimensions of the questionnaire on the status of online learning in the context of the epidemic can be derived. This study defines the analysis framework into two parts: learners and teachers. The student questionnaire consists of basic information about the student on the current situation of online teaching quality and existing problems and survey on students' satisfaction with online teaching quality. The teacher questionnaire consists of teachers' basic information, the current situation of online teaching and the main problems of online education.

Data Collection

In this study, 512 questionnaires were collected, and after screening and elimination, 499 valid questionnaires were obtained, and the questionnaire return rate was 97.5%; 170 questionnaires were collected for the teacher part of the survey, and after screening and elimination, 167 valid questionnaires were obtained for teachers, and the questionnaire return rate was 98.2%.

The reliability of a questionnaire measures the reliability, consistency and stability of a measurement instrument and is an essential aspect of data processing [8]. From the reliability analysis results, the reliability of the student questionnaire scale was high. The agreement coefficient of this scale was 0.943, and the consistency reliability of each dimension ranged from 0.939 to 0.945. The reliability of the teacher questionnaire was higher, in which the agreement coefficient of this scale was 0.918, and the consistency reliability of each dimension ranged from 0.911 to 0.921.

Research Question

This paper aims to address the following two questions:

(1) What is the current state of online teaching in the participating schools?
(2) What are the factors that influence the satisfaction of online teaching in this school?

Results

This study used Excel and SPSS software to analyze the data at three levels: online teaching environment, online teaching practice, and online teaching satisfaction.

Online Teaching Environment Analysis

Teachers adopt different teaching methods according to different teaching needs in online teaching. Teachers mainly used the mode of live tutoring and independent learning, accounting for 43.29%, followed by live classroom accompanied by online tutoring and independent learning, accounting for 24.65%, and live classroom accompanied by recorded resources and independent knowledge and education, accounting for 23.25%. This means that nearly half of the classrooms are still dominated by teachers' live lectures, and the utilization of recorded resources is not high. More than 130 online education companies provide online learning support services to the whole society during the home study period, ensuring the smooth implementation of online teaching [9]. In terms of the online platform, 64.67% of teachers thought it partially met their teaching needs, 23.95% felt that it fully met their teaching needs, and 10.18% believed that the online platform did not meet their teaching needs. This is mainly due to the unstable network status, making it difficult for teachers to manage their classes and interactions effectively. In addition, software crashes and black screens, audio and video jams, delays, noises, and other failures occur in online teaching, affecting learning motivation and effectiveness.

Analysis of Online Teaching Practices

In general, online teaching was orderly, teaching methods diversified, teaching contents, and classroom discipline was properly regulated to achieve the goal of not postponing learning". The survey shows that the online teaching activities organized by teachers are primarily teaching new lessons and answering questions after class. Other online teaching activities include thematic discussions and demonstration of learning outcomes. Traditionally, students' silence in style is considered inattentiveness and lack of seriousness, which is contradictory to effective learning [10]. Teachers use a variety of interactive and motivational approaches to engage students in the classroom. The top three methods of classroom interaction organized by teachers are online tests, roll call questions and Q&A, and enhanced interaction with students through pop-ups and voting. In terms of teaching evaluation, teachers mainly evaluated students based on their homework submission (50.3%) and feedback from online

tests (26.95%). This highlights the one-sidedness of teaching evaluation in online learning. The evaluation subject and method are single and assess academic quality when online learning needs to be analyzed in depth.

Online Teaching Satisfaction and Influencing Factors

Participants

The 499 valid questionnaires on students' satisfaction with online teaching were selected as the basis for empirical analysis. The research mainly focused on students' basic information, online teaching platform and live streaming mode selection, online teaching interaction, teaching resources, teaching support, and students' learning attitude to understand students' overall online teaching evaluation.

The questionnaire results showed that 32.26% of students were very satisfied, 36.67% were satisfied, 26.25% were average, 3.01% were dissatisfied, and 1.8% were very dissatisfied with the effectiveness of online teaching.

Analyses

In this study, exploratory factor analysis was performed on the variables involved, where the KMO value was more significant than 0.7 and Bartlett's spherical test P value was less than 0.05, indicating the suitability of this study for exploratory factor analysis. The total explained variance after rotation was 84.01%. The overall results of the analysis of experimental factors were good. The absolute values of the factor loading coefficients in the rotated component matrix were all greater than 0.4, indicating a strong relationship between the questions and the factors.

This study used correlation analysis to investigate the correlations among the variables, and the Pearson correlation coefficient was used to indicate the correlations.

In the exploratory factor analysis, the author categorized the dependent variables into four categories: teaching objectives of the online course, teachers' teaching style and activities, teaching support, and students' learning efficiency, and the results of the correlation analysis are shown in the table. It can be seen that the four factors and teaching satisfaction present a significant relationship at the 0 0.01 level, and the correlation coefficient values are all greater than 0.3, indicating that there is a relatively strong correlation between these four factors and satisfaction (Table 1).

Since the dependent variable is multi-categorical, a multiple linear regression model was used for the analysis with the following formula: $Y = b0 + b1X1 + b2X2 + b3X3 + b4X4 + E$, where Y is the dependent variable, the independent variable $X1$ denotes the teaching objectives of the online course, the independent variable $X2$ denotes the teaching style and activities of the instructor, the independent variable $X3$ denotes the teaching support given by the instructor, and the independent variable $X4$ represents the learning efficiency of students. The parameters $b0$, $b1$, $b2$, $b3$, and $b4$ indicate the direction and degree of influence of the independent variables on students' satisfaction with online teaching, and the larger the parameter, the more significant the impact of the independent variables on students' satisfaction with online education, and E indicates the random error term.

The data were processed and subjected to multiple linear regression, and the adjusted R^2 was 0.879, which is a good fit. The Durbin-Watson statistic value of 1.938 is close to 2, indicating that the residuals are not serially correlated,

Table 1 Results of correlation analysis

	Satisfaction	Teaching objectives of online courses	Faculty teaching style and activities	Teaching support	Learning efficiency
Satisfaction	1				
Teaching objectives of online courses	0.882[a]	1			
Faculty teaching style and activities	0.897[a]	0.903[a]	1		
Teaching support	0.890[a]	0.865[a]	0.904[a]	1	
Learning efficiency	0.859[a]	0.805[a]	0.809[a]	0.798[a]	1

[a]Indicates a significant correlation at the 0.01 level (two-tailed)

Table 2 Analysis of the number of variances

Models		Square and	Degree of freedom	Mean square	F	Sig
1	Return to	339.218	5	67.844	723.039	0.000
	Residuals	46.259	493	0.094		
	Total	385.477	498			

Table 3 Model regression analysis

Independent variable	Unstandardized coefficient		Standardized coefficient	*T* value	Sig	Covariance statistics	
	B	Standard *d* error	Beta			Tolerance	VIF
Constants	– 0.110	0.071		– 1.543	0.124		
Teaching objectives of online courses	0.204	0.039	0.201	5.171	0.000	0.162	6.178
Faculty teaching style and activities	0.237	0.046	0.233	5.201	0.000	0.121	8.237
Teaching support	0.275	0.039	0.272	7.026	0.000	0.162	6.159
Learning efficiency	0.303	0.030	0.291	10.267	0.000	0.303	3.305

$P < 0.05$ suggests that the model is statistically significant (Table 2).

Results

Table 3 shows model regression results reality, the linear simulation effect of the four variables is good; all passed the significance test. The factors influencing the evaluation of the implementation effect of online teaching were analyzed as follows: the teaching objectives of the online courses were reflected through the clarity of the teaching objectives, whether the teaching objectives met the students' learning needs, whether the teaching resources used contributed to the realization of the teaching objectives and whether they were appropriate to the level of the course content, which was significant at the 1% level with a positive coefficient, indicating that the formulation and realization of the teaching objectives had clearer teaching objectives and the more consistent with the teaching content, the higher the students' satisfaction; the teachers' teaching style and activities are reflected by the teachers' diversified teaching methods; whether the adopted teaching methods are compatible with the online teaching environment and whether the teachers actively interact with the students all affect the students' satisfaction. This factor is significant at the 1% level with a positive coefficient, indicating that teachers' teaching styles and activities have a positive impact on the overall evaluation of online teaching, and the more teachers adopt diverse teaching styles, the more students are motivated to participate in learning, the higher the student satisfaction. Teaching support is reflected by whether teachers can provide timely and accurate feedback, whether they can solve students' problems in learning, and whether they can guide students to participate in learning discussions. The last factor is students' self-learning efficiency, which is reflected by whether students can adapt to the online teaching environment, whether students can attend on time, and whether students can concentrate in online classes. This factor is significant at the 1% level with a positive coefficient and the maximum of the four independent variables, indicating that the teacher's teaching support positively impacts the overall evaluation of online teaching. The higher the students' comfort with online education, the higher the attendance rate and the higher the classroom concentration, the higher the satisfaction with online teaching.

Discussion

First of all, we need pay more attention to the construction of online educational resources to achieve quality resource sharing in online teaching; the teaching resources is in a critical position; the survey found that online teaching resources can fully meet the teaching needs of teachers accounted for only 35.93%, teachers believe that online teaching resources have a single type, small number, lack of personalization of resources and poor quality of resources and other problems.

In developed regions, there are many quality online education resources, localities should further plan and design to include local matching fund investment to bring in, learn and innovate quality online education resources. All the more reason for all sectors of society to take advantage of the strengths of each element and coordinate planning to jointly promote the generation and sustainable development of quality online education resources. Various online teaching platforms and tools ensured the smooth implementation of home learning during the epidemic. The survey found that the online teaching platform could not get timely feedback on students' mastery (67.72%), could not remotely supervise classroom discipline (63.78%), and the venue was not smooth to use and could not withstand a large number of students attending classes at the same time (36.65%). With the development of online education, the teaching platform should pay more attention to teaching management and interaction functions and make better performance in course management, learning records, asynchronous interaction and synchronous interaction.

Next, the successful development of education informatization has made access to knowledge easy and convenient. The growing maturity of online education and the widespread use of MOOCs will impact the traditional ways and

places of education [11]. However, as primary school students are still growing and developing physically and mentally, their ability to discriminate and self-control is weak, which requires intervention and guidance. Unlike the traditional offline classroom, online teaching has the disadvantage of time and space separation, which prevents teachers from getting first-hand information about students' performance, so they need to supplement assessment methods. Teachers can evaluate students in various aspects, such as the number of clicks on the learning materials, the number of times and the length of login to the platform, and so on, by including students' online participation as a reference standard. From a macro perspective, adopting a whole-media learning approach can solve the national teaching and learning problems that arise during the epidemic [12], while at a micro, detailed level, it is essential to implement the role of teachers to play the ground. The appropriate organization of learning resources and the necessary regulation of technological processes will enable teachers to promote and induce students' emotions and thus achieve their teaching objectives. The teacher can change the media design elements to motivate and generate students' feelings effectively. For example, internal emotions can be induced by changing the color of the learning materials, the color of the decorative materials, the size of the text format, and other features.

Teachers must take on a more significant number of tasks during online instruction than during traditional education. Online teachers spend 3–4 times more time per student evaluating and communicating with students than conventional face-to-face instruction. The survey found that 25.75 percent of teachers were particularly favorable, 53.29 percent were profitable, 19.76 percent were less fortunate, and 1.2 percent were not good at the idea of online courses in schools. This indicates that the education authorities do not provide enough incentives for teachers teaching online, which makes some teachers' teaching attitudes not positive. Therefore, schools should develop corresponding incentives and compensation measures to give some compensation to the hard work of frontline teachers. For example, the hours of online lesson preparation, homework correction, and home–school feedback should be included in the workload, and the hours of online work should be taken into consideration when issuing performance pay; teachers should be examined for their online education work experience and performance when evaluating senior titles.

Another issue is that online education is at stake in his epidemic, allowing school education in China to complete a transition from face-to-face teaching to online teaching. The quality of national talent training is closely related to the professional development of primary and secondary school teachers. However, in the survey, it was found that 21.56% of teachers had not attended any training related to online teaching before starting online instruction. Therefore, this emergency shift to online education should be used as a starting point to strengthen the training of teachers' online teaching ability and provide corresponding training opportunities and resources, such as inviting online education experts to schools to conduct special lectures and organizing teachers to participate in online training activities for teachers in online teaching, to improve the online teaching ability of frontline teachers.

Future Prospect

Based on the analysis of the data obtained from the survey, coping strategies to improve the quality of online teaching in the post-epidemic period are proposed at the social level, teacher level, and school level. The social group should pay attention to the construction of educational resources, schools should strengthen teachers' professional development, and teachers should take the initiative to motivate students and give timely feedback to provide references for relevant decisions and related research in the post-epidemic era.

Although the global epidemic situation has now eased, online teaching is still an integral part of education, and the issue of equity in online teaching will continue to be explored in the future, including access to technology and the impact of online learning on underrepresented groups.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s42979-023-01761-w.

Declarations

Conflict of interest XiangQing Wang declares that she has no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Wang Z. Replacing the classroom, or going beyond it?—controversies and reflections on online education. Modern Distance Educ Res. 2020;32(05):35–45.
2. Wang YJ, Bai Y, Ding BR. Does online teaching expand educational inequality—an empirical study based on 13,176 primary and secondary school questionnaires in Jiangsu Province. Shanghai Educ Res. 2020;08:10–5.
3. Yi Ji. Research on the investigation of student satisfaction of flipped classroom. Higher Educ Exploration. 2015;06:85–9.

4. Guoliang Hu, Meichu H. A study on the satisfaction measurement and influencing factors of flipped classroom teaching in adult colleges and universities, an empirical analysis based on MOOCs [J]. J Dist Educ. 2017;35(02):104–12.
5. Hao W, Yongfang H. A research on student satisfaction of university English flipped classroom as a malefactor in Wuyi University [J]. J Wuyi Univ (Social Science Edition). 2019;21(04):85–9.
6. Ting Z, Liang H. Inter-school differences in online learning participation and the factors influencing it, based on a questionnaire survey of high quality and weak high schools during the epidemic [J]. Open Educ Res. 2021;27(01):106–12.
7. Feng YH, Zhang YS, Yue YP. Investigation of online teaching quality practices and optimization strategies in central universities. Digital Educ. 2021;7(01):32–7.
8. Li S, Wang HR, Cui HN, Zheng QH. Exploring the framework of professional standards for online learning service providers. China Distance Educ. 2021;03:12–23.
9. Luo H, Feng QN, Chen Y, Zeng L, Zuo MZ. Research on online teaching platforms and tools for primary and secondary schools during the “war epidemic". Mod Educ Technol. 2020;30(07):113–9.
10. Kong J, Zhao J, Zhang HM. Analysis of online teaching environment, practice design and satisfaction in the context of epidemic. Res Electro-Chem Educ. 2021;42(08):88–92.
11. Die Fu. Where does school education go in the era of artificial intelligence? Modern Educ Manag. 2019;05:52–7.
12. Zhiting Z, Hongchao P. Omni-media learning ecology: A practical solution to the schooling dilemma in times of mass epidemics. Chinese E-learn. 2020;03:1–6.