

# Construction of “Online-Offline” Teaching and Process Evaluation System for Digestive Endoscopy by Standardized Training Doctors\*

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## Abstract

**Objective:** Research the “online-offline” teaching system of digestive endoscopy for doctors and optimize the teaching evaluation system to improve the teaching quality and teaching effect. **Methods:** A total of 57 doctors in digestive endoscopy training from 2017 to 2019 were set as the control group, and a total of 59 people from 2020 to 2022 after the epidemic were set as the research group. The test questions are mainly combined with micro-lecture teaching. Offline the human endoscopy operation is performed first *in vitro*, then *in vivo* with animal models combined with case analysis, and comprehensive guidance and training of regulatory doctors are carried out during the implementation process. Comprehensive evaluation of teaching quality and teaching effect combined with offline assessment and other methods. **Results:** The Direct Observation of Procedural Skills (DOPS) assessment of the research group showed that the training doctor’s endoscope was about *in vitro* operation skills (animals), *in vivo* operation skills (animals), the ability of training doctors to obtain information and operation skills. (human body), analytical and problem-solving ability in digestive endoscopy training, interest in endoscopy learning, innovative thinking, whether the feedback between teachers and training doctors is smooth, and evaluation of “online-offline” teaching system methods Equal dimension evaluation is “excellent” and “good”, and the comprehensive performance and training satisfaction are higher than those of the control group ( $P < 0.05$ ), the DOPS evaluation “moderate” and “poor” and the comprehensive score are below 60 and 61 - 70. The division interval (%) was lower than that of the control group ( $P < 0.05$ ), and the difference was statistically significant. **Conclusion:** The establishment of the “online-offline” teaching system of digestive endoscopy for doctors in

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general training and the optimization of the process evaluation system are beneficial to improve the teaching quality and teaching effect of digestive endoscopy for doctors in general training.

### **Keywords**

Standardized Training Doctors, Digestive Endoscopy Teaching, “Online-Offline” Teaching System, Process Evaluation, Teaching Effect

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## **1. Introduction**

With the rapid development and perfect combination of scientific and technological research and development, industrial manufacturing technology and modern medical diagnostic technology, gastrointestinal endoscopy technology enables gastroenterologists to make more accurate diagnosis and treatment of biliary tract, digestive tract and pancreas (Sun & Chen, 2019; Zhu, Ke, Xue et al., 2019). Compared with internal, external, gynecological, and pediatric diagnostics, endoscopic diagnosis is more practical and has the professional characteristics of integrating diagnosis and treatment, requiring the integration of clinical specialty and basic medical knowledge with endoscopic operation skills, which is abstract and confusing for beginners, and a great challenge for training doctors and teaching teachers (Fan, Hu, Cui et al., 2019; Ji & Yuan, 2019). At the same time, due to the increasing demand of major medical institutions for mastering endoscopy technology, standardized training and the establishment of a reasonable assessment and evaluation system are an important way to promote the training of doctors to master endoscopy technology, and also an important training stage for doctors to master endoscopy technology. How to properly regulate the teaching quality of digestive endoscopy and formulate professional and standardized digestive endoscopy training programs are important guarantees for doctors to master this technology (Lv & Zhou, 2019). The traditional teaching resources of digestive endoscopy are limited, the whole teaching process is mainly dominated by teachers, the teaching mode and assessment method are single, and the training doctors are mostly passive learning, and the active or independent learning is less, while the digestive endoscopy is a clinical technology that focuses on practical operation and strong professional. How to effectively impart relevant knowledge to medical students has always been one of the difficulties in endoscopy teaching (Zhao, Chi, Wang et al., 2019). Therefore, how to establish a perfect teaching method of digestive endoscopy and optimize the teaching evaluation system to improve the teaching quality and teaching effect, and train qualified professional endoscopy technicians or doctors still have space and necessity for further research. Based on this, this study combined modern network technology and existing teaching information resources to integrate the digestive endoscopy teaching of doctors into an “online-offline” teaching system and optimize the teaching evaluation system, which is summarized and shared as follows.

## 2. Data and Methods

### 2.1. Research Object, Grouping and Teaching Method

A total of 57 endoscopy doctors from 2016 to 2018 were set as the control group by retrospective investigation method, and 59 endoscopy doctors from 2019 to 2021 after the epidemic were set as the study group. The control group is the traditional teaching method. Students first watch the teaching video, PPT, PBL, video, etc., get familiar with the operation process, and then directly transition to the clinical practice and take the exam paper after the internship, and finally take the test paper results as the basis for training assessment. On the basis of the traditional teaching plan of the control group, the research group used network technology to integrate “online-offline” teaching resources and increase and optimize the process assessment and evaluation system to comprehensively evaluate the teaching quality and teaching effect of endoscopy (see 2.2 for detailed rules).

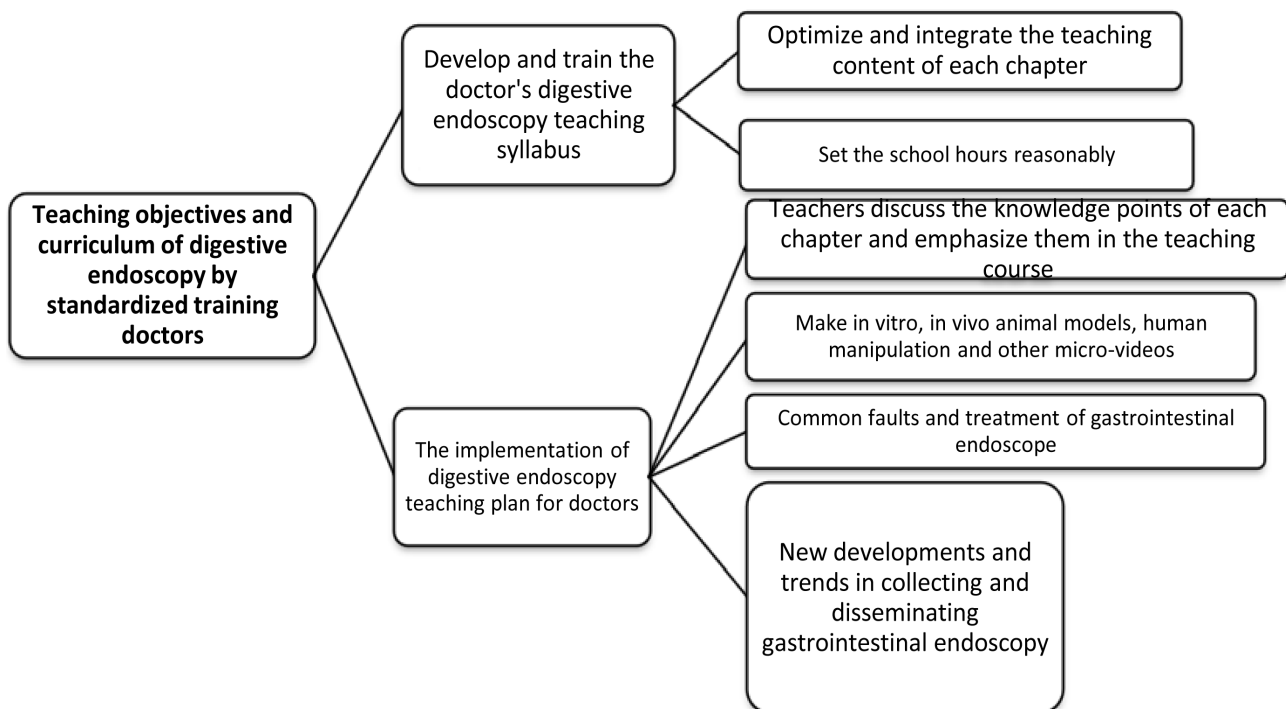
### 2.2. Methods

#### 2.2.1. To Train Doctors Digestive Endoscopy Teaching Objectives and Curriculum

It includes two parts: the formulation of teaching syllabus and the implementation of teaching plan. See **Figure 1**.

#### 2.2.2. Train the Doctor's Digestive Endoscope “Online” Network Platform Construction

It consists of four modules: 1) “online” platform management: 2) information



**Figure 1.** Teaching objectives and curriculum of digestive endoscopy by standardized training doctors.

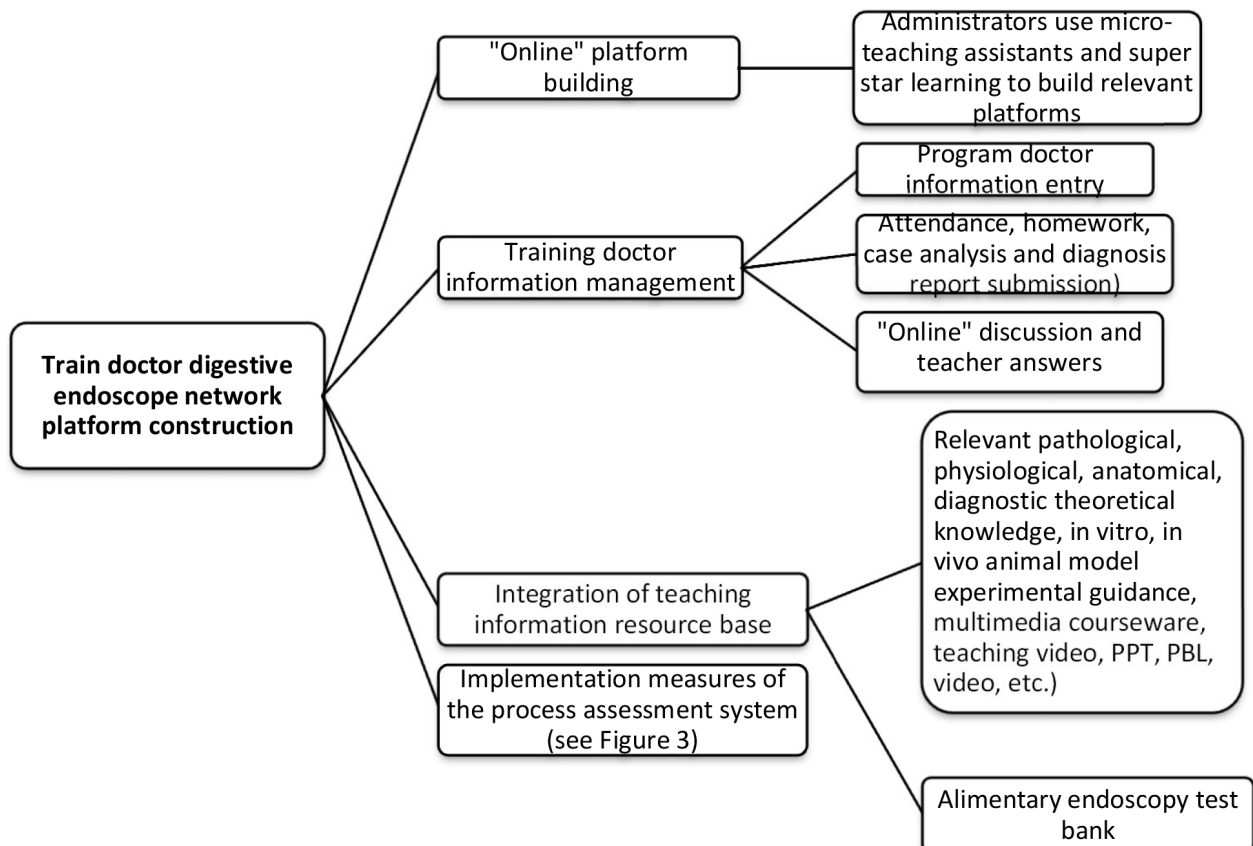
management of trained doctors: 3) integration of teaching information resource database: 4) implementation methods of the process assessment system. See **Figure 2**.

### 2.2.3. "Offline" Course Construction of Digestive Endoscopy for Doctors

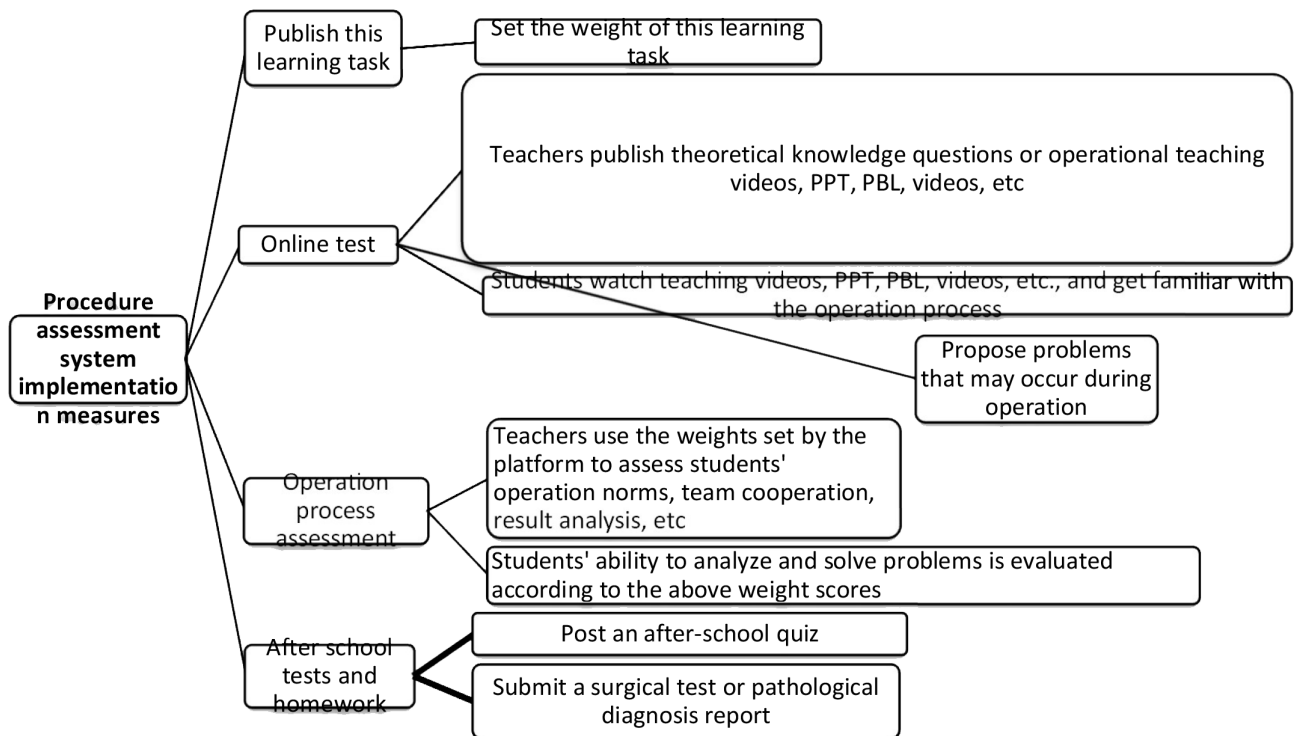
Including *in vitro* and *in vivo* animal model preparation and endoscopic experiments, and finally under the guidance of teachers combined with case analysis and human endoscopic operation.

### 2.2.4. "Online-Offline" Process Assessment and Evaluation System

According to the teaching syllabus and teaching plan, the doctor training should pay attention to the process assessment and identify the teaching effect. "Online" process assessment includes online learning (10%), attendance (10%), online testing (10%), etc. "Offline" includes first *in vitro* (10%), then *in vivo* animal model (20%), and finally under the guidance of teachers combined with case analysis (10%) and then human endoscopy operation (30%). Each assessment index is 100 points. Finally, comprehensive results after the training are obtained by combining the total weight of the above assessment indicators. The "online" process assessment includes the distribution of comprehensive score interval (%), comprehensive score, satisfaction, etc. Among them, the comprehensive score interval is divided into less than 60 points, 61 - 70 points, 71 - 80 points, 81



**Figure 2.** Construction of digestive endoscopy network teaching platform for doctors.



**Figure 3.** Procedures for implementing the digestive endoscopy process assessment system.

- 90 points, 91 - 100 points, and the percentage (%) of each interval is calculated.

### 2.2.5. Standardized Training Doctors Evaluated the Teaching Quality and Teaching Effect of “Online-Offline” Teaching System

A questionnaire was used to collect the scores of standardized training doctors' Direct Observation of Procedural Skills (DOPS) on the “online-offline” teaching system and evaluate the degree of recognition and teaching effect. DOPS was evaluated with a 50-point system, and each evaluation was divided into four levels: Excellent (46 - 50 points), good (40 - 45 points), Good (30 - 39 points), not good (<30 points) (Hengameh, Afsaneh, Morteza et al., 2015; Wang, Hao, Li et al., 2021).

## 2.3. Statistical Methods

The statistical software was SPSS 22.0, and the data were expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ). The pairwise comparison between groups was performed by Dunnett t test of the mean of two samples, and the comparison between groups was performed by  $\chi^2$  test.  $P < 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Analysis of DOPS Results

In the DOPS evaluation of the research group, there were questions about the skill of non-exercise (animal), the skill of exercise (animal), the ability of the training doctor to obtain relevant information, the operation skill (human), the

ability to analyze and solve problems in the digestive endoscopy training, the interest in endoscopy learning, the innovation of thinking, whether the feedback between the teacher and the training doctor was smooth, and the “online-offline” teaching system method The DOPS of “excellent” and “good” were higher than those of the control group ( $P < 0.05$ ), while those of “medium” and “poor” were lower than those of the control group ( $P < 0.05$ ), and the difference was statistically significant. See **Table 1**.

### 3.2. Comparison of Comprehensive Score Interval (%) Distribution, Comprehensive Score and Satisfaction between the Two Groups

The study group with scores below 60 and 61 - 70 interzone (%) was lower than the control group, 71 - 80, 81 - 90, 91 - 100 interzone (%) and after the training were higher than the control group ( $P < 0.05$ ), the difference was statistically significant. See **Table 2**.

**Table 1.** Comparison of DOPS results between the two groups [n (%)].

item	group	Excellent	good	medium	poor
Gymnastic skill (animal)	Control group	17 (29.82)	22 (38.60)	12 (21.05)	6 (10.53)
	Research group	21 (35.59) <sup>a</sup>	27 (45.76)	9 (15.25) <sup>a</sup>	2 (3.39) <sup>a</sup>
Skills in gymnastics (Animal)	Control group	16 (28.07)	25 (43.86)	11 (19.30)	5 (8.77)
	Research group	20 (33.90) <sup>a</sup>	29 (49.15)	8 (13.56) <sup>a</sup>	2 (3.39) <sup>a</sup>
Handling skills (human)	Control group	18 (31.58)	22 (38.60)	13 (22.81)	4 (7.02)
	Research group	22 (37.29) <sup>a</sup>	27 (45.76)	9 (15.25) <sup>a</sup>	1 (1.69) <sup>a</sup>
The ability of the doctor to obtain relevant information	Control group	15 (26.32)	20 (35.09)	15 (26.32)	7 (12.28)
	Research group	26 (44.07) <sup>a</sup>	24 (40.68)	9 (15.25) <sup>a</sup>	0 (0.00) <sup>a</sup>
Interest in endoscopy	Control group	17 (29.82)	25 (43.86)	10 (17.54)	5 (8.77)
	Research group	24 (40.68) <sup>a</sup>	28 (47.46)	6 (10.17)	1 (1.69) <sup>a</sup>
The ability to analyze and solve problems during digestive endoscopy training	Control group	20 (35.09)	23 (40.35)	7 (12.28)	7 (12.28)
	Research group	26 (44.07) <sup>a</sup>	27 (45.76)	4 (6.78) <sup>a</sup>	2 (3.39) <sup>a</sup>
Whether the feedback between the teacher and the doctor is smooth	Control group	12 (21.05)	20 (35.09)	12 (21.05)	13 (22.81)
	Research group	28 (47.46) <sup>a</sup>	24 (40.69)	6 (20.34) <sup>a</sup>	1 (1.69) <sup>a</sup>
Innovative thinking	Control group	20 (35.09)	21 (36.84)	9 (15.79)	7 (12.28)
	Research group	26 (44.07) <sup>a</sup>	25 (42.37)	6 (10.17) <sup>a</sup>	2 (3.39)
Whether the feedback between the teacher and the doctor is smooth	Control group	12 (21.05)	19 (33.33)	15 (26.32)	11 (19.30)
	Research group	27 (45.76) <sup>a</sup>	23 (38.98)	7 (11.86) <sup>a</sup>	0 (0.00) <sup>a</sup>
Evaluation of “online-offline” teaching system method	Control group	15 (26.32)	20 (35.09)	10 (17.54)	12 (21.05)
	Research group	26 (44.07) <sup>a</sup>	27 (45.76)	6 (10.17) <sup>a</sup>	0 (0.00) <sup>a</sup>

Note: Compared with control group, <sup>a</sup> $P < 0.05$ .

**Table 2.** Distribution of comprehensive score interval (%) and comparison of comprehensive score and satisfaction between the two groups [n (%)].

group	A score of 60 or less	61 - 70	71 - 80	81 - 90	91 - 100	After the training	the comprehensive score is full conjuncture
Research group	0 (0.00) <sup>a</sup>	2 (3.39) <sup>a</sup>	17 (28.81) <sup>a</sup>	25 (42.37) <sup>a</sup>	15 (25.42) <sup>a</sup>	89.25 ± 11.28 <sup>a</sup>	93
Control group	2 (3.51)	8 (14.04)	14 (24.56)	22 (38.60)	11 (19.30)	76.19 ± 10.56	79

Note: Compared with control group, <sup>a</sup> $P < 0.05$ .

#### 4. Discussion

The rapid development of endoscopy technology has significantly improved the level of diagnosis and treatment of digestive system diseases, and the role of digestive endoscopy in the diagnosis and treatment of digestive system diseases has become increasingly significant. At the same time, the demand and ability of endoscope operators have also increased day by day (Zhang, 2019). Therefore, mastering the operation technology of digestive endoscopy has become an important subject in the standardized training of digestive endoscopy for trained doctors in various teaching hospitals. For this reason, since 2015, China has officially launched the standardized training of resident physicians in combination with the 2015 edition of the US BLS guidelines. The Digestive Endoscopy Branch of the Chinese Medical Association made a brief summary of the development of digestive endoscopy in China in the past year, including detailed guidance on the training of digestive endoscopy doctors (Li, 2016; Hu, Yang, Huang et al., 2021). In order to improve the overall skill operation and diagnosis level of the digestive endoscope training doctors, exploring and developing diversified digestive endoscope training programs to improve the teaching quality and teaching effect of digestive endoscopy is an important guarantee for the training doctors to master this technology.

After years of practice in the teaching of digestive endoscopy, our hospital has developed diversified teaching methods, such as the recently completed “online-offline” teaching and evaluation system of digestive endoscopy for doctors. In addition to the traditional teaching implementation plan, network technology is used to integrate the “online-offline” teaching and evaluation system, so that teachers and students can communicate and interact in every step of the teaching process. Students’ learning of digestive endoscope can be gradually and gradually transition to clinical practice. Standardized training is carried out in combination with various teaching methods such as case teaching, simulation teaching, experimental animal teaching, demonstration teaching and clinical “hand by hand” teaching, so that the trained doctors have enough time to think about the operation process and their enthusiasm for learning is significantly increased. The learning efficiency has been greatly improved (An, Shi, Sun et al., 2019). In this study, DOPS results showed that In the DOPS evaluation of the research group, there were questions about the skills of non-exercise (animal),



skills of exercise (animal), ability of training doctors to obtain relevant information, operation skills (human), ability to analyze and solve problems in digestive endoscopy training, interest in endoscopic learning, innovation of thinking, whether the feedback between teachers and training doctors was smooth, and the method of “online-offline” teaching system Those with “excellent” and “good” DOPS were higher than the control group, while those with “moderate” and “poor” DOPS were lower than the control group. It is suggested that the method of “online-offline” teaching system can optimize the allocation of teaching equipment and teaching resources, and effectively realize the sharing of high-quality teaching resources. Standardized training doctors use the “online” platform of digestive endoscopy teaching to learn, which reflects the teaching concept centered on standardized training doctors, and effectively breaks the boundaries of time and space. At the same time, since digestive endoscopy is a highly operational diagnosis and treatment discipline, pure “online” teaching is not conducive to the cultivation of operational ability and the ability to observe and analyze problems. To this end, the “offline” was added, including the preparation of *in vitro* and *in vivo* animal models and endoscopic experiments, and then the human endoscopic operation was carried out under the guidance of teachers combined with case analysis. After the comprehensive assessment of the process evaluation system, the comprehensive scores of the study group were lower than the control group in the interval distribution of 60 points and 61 - 70 points, and the comprehensive scores of 71 - 80, 81 - 90, 91 - 100 points and the satisfaction of the training between the regions were higher than the control group. It is suggested that the construction of “online-offline” mixed teaching can create a good learning atmosphere, fully mobilize the learning enthusiasm and initiative of the training doctors, improve the autonomy and interaction of learning, give full play to the respective advantages of “online-offline” teaching, make them complement each other and work together, and finally achieve the established goals (Xu, Li, Li et al., 2015; Guo, Zhang, Han et al., 2020). This teaching method is conducive to the overall development of the professional career of the doctors, so that the “teaching and learning” of the subject is harmonious and unified, and it opens up the vision of the doctors, expands the learning space, and makes the knowledge of the doctors broader and deeper. In the course of teaching, the doctors agreed to this teaching method, which greatly improved the teaching quality and effect.

In short, by reasonably setting the teaching objectives and courses of digestive endoscopy, building the “online” network platform and “offline” platform of digestive endoscopy, developing a reasonable “online-offline” teaching system and evaluating the teaching effect of the “online-offline” teaching system, It has realized a teaching and learning platform integrating independent learning, teacher guidance and experimental teaching for doctors, optimized the teaching process and management level, paid attention to the advancement of educational content, stimulated the learning interest of doctors, provided teachers with a convenient and fast management platform, and also provided doctors with an inde-



pendent and open learning environment. This has significantly improved standardized training doctors' digestive endoscopy skills (Wu, Zhu, Hao et al., 2019). In the era of rapid development of the information Internet, the construction of the "online-offline" teaching and procedural evaluation system of standardized training doctors' digestive endoscope not only retains the intuitionistic and operable nature of traditional teaching, but also organically combines theory, practice and network. With the help of the network platform, teachers and students can interact and solve questions in the learning process in a timely and effective manner. It provides a lot of convenience for related teaching work, makes the way to acquire knowledge more convenient, enrich the classroom content, enable students to update knowledge and obtain information infinitely, obtain useful medical information, broaden their knowledge horizon, and constantly improve their professional ability, skills and comprehensive quality. At the same time, it also stimulates students' enthusiasm for learning and strengthens their understanding of knowledge points. The teaching quality has been greatly improved (Huang, Zhang, Zhao et al., 2022; In Liangliang, but Green, 2019).

As a comprehensive clinical skill discipline, endoscopy has a strong interdisciplinary and practical. Under the new situation and in the Internet information age, it is still necessary to study how to do a good job in continuing medical education for gastroenterologists, construct functional rooms with professional characteristics by using existing technologies and abundant disciplinary resources, and construct a reasonable and efficient digestive endoscopy teaching and process evaluation system for training doctors.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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