Application and Evaluation of Flipped Teaching Based on Video Conference in Standardized Training for Internal Medicine Residents during Vacation

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Abstract

Background: The training in the department of infectious diseases is a compulsory part of the standardized training for internal medicine residents, and the specialized hospitals for infectious diseases provide specialized training for residents in hospitals without the training standards for the department of infectious diseases in the region. However, due to holidays, coordination of training dates among hospitals, and vacation of other reasons, the actual training time of the department of infectious diseases may be insufficient.

Objective: Flipped teaching with "video conference" as the carrier was explored during vacation, to make up for the lack of actual training time of the department of infectious diseases for internal medicine residents caused by vacation, and to ensure the training quality of the department of infectious diseases.

Methods: Vertical management mode was adopted, management team and lecturer team were established, training program and teaching implementation were formulated. Flipped teaching was carried out on the carrier of "video conference" for internal medicine residents of dispatched hospitals who participated in the training of infectious diseases department in April. Qualitative and quantitative analysis was made on the design and implementation of flipped teaching.

Results: The flipped teaching was organized and vertically managed by the contact person of the project of "Rotation Training for Infectious Diseases

Department of Internal Medicine Residents". 19-member internal medicine residents participated in this teaching, and a 6-member management team was formed, and a 12-member lecturer team was composed of 12 internal medicine residents who had been trained in the department of infectious diseases from March to April. 12 training contents were selected to carry out teaching according to the requirements of training diseases in the department of infectious diseases, and the implementation rate of teaching plan was over 90%. A total of 197 feedback questionnaires were collected. The feedback that the teaching quality was "good" and "very good" accounted for more than 96%, and the attendance rate of the whole teaching process reached more than 94%. About this teaching, 6 internal medicine residents put forward 18 suggestions for improvement, accounting for 9.1%; and 11 internal medicine residents gave 110 commendation suggestions, accounting for 55.8%.

Conclusion: Flipped teach based on video conference was generally effective in carrying out for internal medicine residents participating in the training of department of infectious diseases, and it could be used as a supplementary training method for standardized training of internal medicine residents to make up for the shortage of actual training period in a certain stage.

[Key words] Flipped teaching; Resident physician in internal medicine; Standardized training; Medical teaching

Introduction

In view of the rapid evolution of infectious diseases spectrum in Shanghai in recent years and the need for effective response to public health emergencies, the department of infectious diseases was decided to be included in the compulsory rotation subject of standardized training for internal medicine residents, so as to further improve the knowledge structure of internal medicine residents and meet the social demand for the diagnosis and treatment of infectious diseases. For the training hospitals that do not have a ward of the department of infectious diseases, or the training hospitals that cannot master the diseases required for the training of the department of infectious diseases, internal medicine residents of which should be arranged to attend the training of the department of infectious diseases of Shanghai Public Health Clinical Center.[1]

With the continuous promotion of the training of infectious diseases department for internal medicine residents in Shanghai, more and more hospitals participated in the collaborative training of internal medicine residents in Shanghai Public Health Clinical Center, and the number of internal medicine residents entering the training base of infectious diseases department of Shanghai Public Health Clinical

Center gradually had been increasing. According to the requirements of the standardized training program for internal medicine residents, internal medicine residents attending the training in the department of infectious diseases in the Shanghai Public Health Clinical Center needed to carry out professional training for 1-2 months. In order to unify management and training, it was necessary to arrange a certain number of internal medicine residents to enter Shanghai Public Health Clinical Center for infection department training in an orderly manner every month, and make orderly connection so as to ensure the quality of training and rational use of public medical resources. During the operation of the project, the training cycle of internal medicine residents in the department of infection might be insufficient due to holidays, coordination of training dates between multiple hospitals, and other subjective and objective reasons. Therefore, we explored a new teaching mode to further improve the training work of the department of infection.

In the flip teaching research report, the flipped classroom approach in health professions education yielded a significant improvement in student learning compared with traditional teaching methods[3], the flipped classroom and lecture were essentially equivalent[4], and an increased perceived value and acceptability of this model was noted by the participants[5]. Therefore, we explored the use of "video conference" as the carrier to carry out flipped teaching, and constructed the teaching mode of "flipped teaching in standardized training for internal medicine residents based on video conference" to perform distance online teaching. The mode was applied to the training of infectious diseases department of internal medicine residents, and preliminary evaluation was conducted.

Objects and Methods

Subjects

The study objects were internal medicine residents who planned to take training in the department of infectious diseases at the Shanghai Public Health Clinical Center in April. And they were also physicians who had participated in the standardized training for residents in Shanghai. Their dispatched hospital had signed an "Agreement on Joint Training of Internal Medicine Residents" with Shanghai Public Health Clinical Center. The informed consents of participants in internal medicine residents were obtained, including their data being used for the training and the research, and that this study was conducted in accordance with the Declaration of Helsinki.

Construction of Flipping Teaching Mode with Video Conference as the Carrier

The flipped teaching with video conference as the carrier adopted "vertical management mode" for management[2], and management team and lecturer team were established. According to the training requirements of the department of infectious diseases in the Standardized Training Content and Standard for Resident Physicians (2021 Edition) -- Internal Medicine Training Rules, the management team would formulate the training program, and the lecturer team would select the training content and carry out teaching activities according to the plan. The whole teaching activity was carried out online by "video conference", involving teaching organization, training, after-class discussion and teaching management, etc.

Evaluation Indexes and Methods

Six teaching plan indicators (teaching on the planned time, teaching on the planned content, making PPT fully, providing references, unifying the teaching content and training program, and participating in after-class discussion) were established to evaluate the implementation of the teaching plan. Nine teaching quality indicators (rigorous teaching attitude, punctual class, detailed and accurate teaching content, reasonable structure and clear process, highlighting teaching key points, clear teaching difficulties, accurate and refined language, combining theory with clinical practice, improving ability to analyze and deal with the disease) were used to evaluate the teaching quality. Three attendance indicators (online on time, middle roll call and end on time) were established to evaluate the online attendance of internal medicine residents. And three overall evaluation indicators (suggestions for improvement, no special suggestions, praise highlights) were established to evaluate the overall situation of this teaching.

Teaching plan index and attendance index were completed online in real time, teaching quality index and overall evaluation index were completed by questionnaire star. Among them, teaching plan index, attendance index and teaching quality index were objective indexes, while overall evaluation index was subjective. Content analysis method was adopted for subjective indicators. Such as: the feedback of improvement needed or deficiency was classified as "improvement suggestions"; all recognized the teaching, the evaluation content was all praise highlights and learning achievements, the feedback of the above was classified as "praise highlights"; the feedback on this teaching without suggestions was classified as "none".

Software Application

Video Conference adopted "Tencent Conference" software to carry out online

teaching, PPT playing, lecturing by physicians, participating in questions, online answering, online check-in and discussion, dynamic monitoring, whole-process management, etc.

The software "Questionnaire Star" was used to develop 9 teaching quality indicators and 3 overall indicators, and carry out star survey after class.

SPSS software version 23.0 (SPSS Inc. Chicago, IL, USA) was used for statistical analysis of the data. and the counting data was represented by example (%) to reflect the composition ratio of the study indicators. The data conforming to normal distribution were expressed as mean ± standard deviation to reflect the distribution of the study indicators.

Results

Basic Information of Physicians Participating in Teaching Activities

A total of 19 internal medicine residents participated in the "flipped teaching" program, all from tertiary hospitals. Among them, 9 were male, accounting for 47.4%. The average age was 29.5 years. 5 had bachelor degree, accounting for 26.3%; 4 had master degree, accounting for 21.1%; 10 had doctor degree, accounting for 52.6%. 17 internal medicine residents were qualified as practicing physicians, accounting for 89.5%. 2 in the first year of training, accounting for 10.5%. 12 in the second year of training, accounting for 63.2%. 5 in the third year of training, accounting for 26.3%. 12 would be trained in the department of infectious diseases from March to April according to the plan, accounting for 63.1%; 7 would receive training in the department of infectious diseases from April to May according to the plan, accounting for 36.8%. See Table-1 for details.

Table-1 Baseline of Internal Medicine Residents Participating in Flipped Teaching

Indicators	
Total number [n,(%)]	19(100)
Sexuality [male,n,(%)]	9(47.4)
Age [years,Mean±standard deviation]	29.5±3.1
Education background	
Bachelor degree[n,(%)]	5(26.3)

Master degree[n,(%)]	4(21.1)
Doctor degree[n,(%)]	10(52.6)
Qualified as a licensed physician [n,(%)]	17(89.5)
Training phase	
First year of training[n,(%)]	2(10.5)
Second year of training[n,(%)]	12(63.2)
Third year of training[n,(%)]	5(26.3)
From tertiary hospitals [n,(%)]	19(100)
Training period in the department of infectious diseases	
March - April[n,(%)]	12(63.1)
April - May[n,(%)]	7(36.8)

Flipped Teaching Organization

The flipped teaching was organized and implemented by the contact person of the "Rotation Training of Infectious Diseases Department for Internal Medicine Residents" project, which was managed by the "vertical management mode". The management team was formed together with the monitor and group leader of this training course, and 12 internal medicine residents were the lecturers in the training period of infectious diseases department from March to April.

The content of the lecture is as follows: Analysis of Chronic Hepatitis B, Study on Guidelines for Prevention and Treatment of Hepatitis C (2019 Edition), Identification and Treatment of Clostridium Difficile Associated Diarrhea, Bacterial Liver Abscess, Diagnosis and Treatment of Tuberculosis, Guidelines for the Diagnosis and Treatment of Syphilis, Diagnosis and Treatment of Tuberculous Meningitis, Infective Endocarditis, Cryptococcal Meningitis, Study on AIDS Diagnosis and Treatment Guide in China (2021 edition), Diagnosis and Treatment of Cirrhotic Ascites, Diagnosis and Treatment of liver Failure. Teaching tasks were assigned to individuals according to the time period, and PPT was developed to carry out teaching activities according to clinical guidelines. See Table-2 for details.

Table-2 Flipped Teaching Plan

No.	Teaching date	Teaching time	content of courses
1	April 1	13:35-14:20	Analysis of Chronic Hepatitis B
2	April 1	14:35-15:20	Study on Guidelines for Prevention and Treatment of Hepatitis C (2019 Edition)
3	April 1	15:35-16:20	Identification and Treatment of Clostridium Difficile Associated Diarrhea
4	April 2	13:35-14:20	Bacterial Liver Abscess
5	April 2	14:35-15:20	Diagnosis and Treatment of Tuberculosis
6	April 2	15:35-16:20	Guidelines for the Diagnosis and Treatment of Syphilis
7	April 3	13:35-14:20	Diagnosis and Treatment of Tuberculous Meningitis
8	April 3	14:35-15:20	Infective Endocarditis
9	April 3	15:35-16:20	Cryptococcal Meningitis
10	April 4	13:35-14:20	Study on AIDS Diagnosis and Treatment Guide in China (2021 edition)
11	April 4	14:35-15:20	Diagnosis and Treatment of Cirrhotic Ascites
12	April 4	15:35-16:20	Diagnosis and Treatment of liver Failure

Evaluation of Teaching Plan Implementation

The flipped teaching was carried out according to plan, with real-time online management and evaluation. In the teaching process, one of the lecturers delayed the start time of teaching on the planned time, because he was not familiar with "Video Conferencing" software; and the rest of the lecturers carried out teaching activities on time. Teaching plan met the requirements for 11 times, accounting for 91.7%. All the other teaching plan indicators were in compliance with the compliance rate of 100%. See Table-3 for details.

Table-3 Statistical Table of Evaluation of Teaching Plan Implementation

No.	Teaching plan indicators	CT	NCT	CR (%)
1	Teaching on the planned time	11	1	91.7
2	Teaching on the planned content	12	0	100
3	Making PPT fully	12	0	100
4	Providing references	12	0	100
5	Unifying the teaching content and training program	12	0	100
6	Participating in after-class discussion	12	0	100

Abbreviations: CT, Coincidence times ; NCT, Not-Coincidence times; CR, Coincidence rate.

Note: Coincidence rate (%) = Coincidence times of teaching indicators / Total times of teaching indicators *100%.

Evaluation of Teaching Quality

The teaching quality of the flipped teaching was investigated from the questionnaire star, and 179 effective feedback questionnaires were collected. Feedback "good" of six indicators ("Rigorous teaching attitude", "Punctual class", "Detailed and accurate teaching content", "Reasonable structure and clear process", "Highlighting teaching key points", "Clear teaching difficulties", "Accurate and refined language", "Combining theory with clinical practice", "Improving ability to analyze and deal with the disease") was 26, 29, 36, 33, 32, 33, 31, 28 and 30, accounting for 13.2%, 14.7%, 18.3%, 16.8%, 16.3%, 16.8%, 15.8%, 14.3% and 15.3%, respectively. And Feedback "very good" of the above six indicators 170, 167, 157, 159, 162, 157, 161, 163 and 163, accounting for 86.3%, 84.8%, 79.7%, 80.7%, 82.2%, 79.7%, 81.7%, 82.7% and 82.7%, respectively. Overall, teaching quality was rated as "good" and "very good" by more than 96%. See Table-4 for details.

Table-4 Statistical Table of Flipped Teaching Quality Evaluation

No.	Teaching quality indicators[n,(%)]	VP(%)	Poor(%)	General(%)	Good(%)	VG(%)
1	Rigorous teaching attitude	0(0)	0(0)	1(0.5)	26(13.2)	170(86.3)
2	Punctual class	0(0)	0(0)	1(0.5)	29(14.7)	167(84.8)

3	Detailed and accurate teaching content	0(0)	0(0)	4(2.0)	36(18.3)	157(79.7)
4	Reasonable structure and clear process	0(0)	0(0)	5(2.5)	33(16.8)	159(80.7)
5	Highlighting teaching key points	0(0)	0(0)	3(1.5)	32(16.3)	162(82.2)
6	Clear teaching difficulties	0(0)	0(0)	7(3.5)	33(16.8)	157(79.7)
7	Accurate and refined language	0(0)	0(0)	5(2.5)	31(15.8)	161(81.7)
8	Combining theory with clinical practice	0(0)	0(0)	6(3.0)	28(14.3)	163(82.7)
9	Improving ability to analyze and deal with the disease	0(0)	0(0)	4(2.0)	30(15.3)	163(82.7)

Abbreviations: VP, Very poor ; VG, Very good.

Note : 197 feedbacks on teaching quality evaluation were collected through questionnaires.

Teaching Attendance and Feedback

The whole process of attendance was checked for this flipped teaching, and the three time nodes of "online on time", "middle roll call" and "end on time" were included in the statistics. There were 18, 18 and 19 residents in attendance at the above three time nodes, and the attendance rates were 94.7%, 94.7% and 100% respectively. One of them failed to go online on time because he was not familiar with "video conference" software, and one asked for leave and went offline due to an emergency. See Table-5 for details.

Table-5 Attendance of of Flipped Teaching

No.	Attendance indicators	Residents in attendance	Attendance rates(%)
1	Online on time	18	94.7
2	Middle roll call	18	94.7
3	End on time	19	100

Note: Attendance rate (%) = Number of residents in attendance / Total number of participants in the training of the infectious diseases department *100%

In the overall evaluation of the flipped teaching, 6 internal medicine residents filled in suggestions for improvement in 18 questionnaires, accounting for 9.1%; 11

internal medicine residents proposed praise highlights in 110 questionnaires, accounting for 55.8%. 10 internal medicine residents had no special feedback in 69 questionnaires, accounting for 35.0%. See Table-6 for details.

Table-6 Overall Evaluation of Flipped Teaching

No.	Overall evaluation indicators	NPE	RPE(%)	TTE	RTET(%)
1	Improvement suggestions	6	31.6	18	9.1
2	None	10	52.6	69	35
3	Praise highlights	11	57.9	110	55.8

Abbreviations: NPE, Number of participants in evaluation; RPE, Ratio of participants in evaluation; TTE, Times of teaching evaluations; RTET, Ratio of teaching evaluation time.

Note: Ratio of participants in evaluation (%) = Number of participants in evaluation / Total participants in the training of the infectious diseases department *100%

Ratio of teaching evaluation times (%) = Times of teaching evaluations of overall evaluation indicators / Total times of teaching evaluation *100%

197 feedbacks on overall evaluation were collected through the questionnaires.

Discussion

The participation of medical residents in the training of infectious diseases department was carried out under specific conditions, which was the perfection of the knowledge structure of the standardized training of medical residents and the social needs for the diagnosis and treatment of infectious diseases. Hospitals that did not meet the training standards for infectious diseases should cooperate with Shanghai Public Health Clinical Center to train internal medicine residents. Due to the fact that the internal medicine residents who participated in the infectious diseases department training of Shanghai Public Health Clinical Center came from more than 10 hospitals in Shanghai, the personnel management, and implementation plan and training progress of internal medicine residents in each hospital were different to some extent. In order to ensure the quality of internal medicine resident training and rationally allocate the training resources of the department of infectious Diseases, a certain number of internal medicine residents were accepted to participate in the training of the department of infectious diseases of Shanghai Public Health Clinical Center every month. In the actual operation, due to involve legal holidays, vocations for other reasons and

emergencies; some of the internal medicine residents trained in the department of infectious diseases could not meet the training time requirements. To this end, we carried out video conference as the carrier to carry out standardized training in the department of infectious diseases for internal medicine residents. Therefore, it is obviously advanced and necessary to carry out the application and research of flipped teaching.

Flipped classrooms showed many advantages when tested in a radiology classroom setting, making up for some inadequacies of didactic classrooms; but it was needed to make improvements to make it more suitable for the Chinese medical education mode.[6] The flipped classroom approach showed promise in ophthalmology clerkship teaching; but, it had some drawbacks; further evaluation and modifications were required before it could be widely accepted and implemented.[7] Based on the above, we carried out this teaching model research. The whole "flipped teaching" mode involved organizational structure, training content, training plan, training implementation, training management and evaluation. This teaching research was a prospective study, establishing organizational structure and management model, developing training content and training plan. Through online assessment and after-school questionnaire survey to evaluate the implementation and quality analysis of the teaching model. Then the practicability, rationality, feasibility and effectiveness of this teaching model were evaluated. Therefore, this teaching research has distinct scientific nature.

The teaching organization structure included training organization, management mode, management team and lecturer team. This training was organized and implemented by the contact person of the "Rotation Training of Infectious Diseases Department for Internal Medicine Residents" project, to ensure the cooperation and support of teaching administrative departments and internal medicine residents of each hospital dispatched, and to mobilize the enthusiasm of internal medicine residents during the training of infectious diseases department for this teaching work. A management team of six was set up in this teaching work, which were used to assist the project contact person to organize and implement this teaching activity, manage, host, ask questions and summarize the teaching tasks of each group in groups, and supervised the teaching plan and supporting work, In order to further develop the group's subjective initiative. A total of 12 lecturers were organized, consisting of 12 lecturers who had trained in the department of infectious diseases in Shanghai Public Health Clinical Center in March, and their training period in the department of infectious diseases was two months from March to April. They had one-month training experience in the department of Infectious diseases. They chose target diseases to give lectures

based on their own clinical practice and shared their learning experience of this disease. In this way, the teaching could encourage the lecturers to learn and summarize the clinical knowledge of the selected diseases. 12 lecturers were selected to encourage more qualified lecturers to participate in teaching activities and ensure the coverage of the teaching content. This teaching adopted vertical management mode. Since the "vertical management mode" established by us had gained good experience and evaluation in the field of standardized training for public health physicians[2], this mode was adopted in this teaching organization, which also reflected that the teaching organization had very good practicability.

The content of this teaching was based on the establishment of the training program of infectious diseases department for internal medicine residents, with the orientation of the essential diseases and key diseases in the infectious diseases department training. The goal of this teaching was to train the diagnosis and treatment skills of infectious diseases for internal medicine residents. The main contents were based on the clinical diagnosis and treatment guidelines of infectious diseases. All above was to ensure that the teaching purpose was consistent with the training of the department of infectious diseases, and they made certain that the teaching met the requirements of standardization, homogeneity and standardization of residents. According to the requirements of the training program of the department of infectious diseases, 12 diseases were selected as the main topics of the teaching, covering all the diseases that must be mastered by the training of the department of infectious diseases, and involving other key diseases of the department of infectious diseases. Therefore, the teaching and training content was reasonably designed, which met the needs of the training of infectious diseases department at the level of internal medicine residents and reflected the rationality of the teaching mode.

In the part of planning implementation, it was an important part of teaching work to formulate training plans and organize implementation under the condition of definite training content. In order to carry out the teaching contents in an orderly manner, targeted teaching plans were drawn up, and the teaching contents needed to be implemented for specific personnel and specific time periods, so that the lecturers and participating physicians could make full preparations. The management group made a good teaching time frame, and the lecturers took the initiative to participate, and selected their own lecturing content and lecturing time. Once the content of the lecture was determined, no modification would be made. The lecturing time should be adjusted in an emergency manner, and the lecturing time should not be adjusted if the teaching can be carried out as planned. If teaching could not be carried out within the

planned time period, the lecturer's teaching should be adjusted to the last time period in an orderly manner. The original plan of the 12 disease teaching tasks was to be completed in 4 days, and three time periods were arranged for orderly teaching activities every afternoon. In the implementation of the teaching plan, it was adopted for unified planning, group management, classified hosting, punctual teaching, on-site discussion, whole attendance, and "Questionnaire Star" questionnaire after class. If the original teaching plan could not be implemented due to an emergency, the teaching time would be changed according to the emergency adjustment plan. In this teaching activity, one of the lecturers delayed the start time of teaching, because he was not familiar with "video conference" software. Therefore, in the formal organization of teaching activities, teaching preparation should be done more carefully for every section. For example, software drills and trial lectures should be carried out in the early stage of teaching. In the process of teaching implementation, the proportion of "Teaching on the planned time" was 91.7%, and the proportion of "Teaching on the planned content", "PPT making fully", "providing references", "unifying teaching content and training outline" and "participation in after-class questions" was 100%. From the perspective of teaching arrangement and implementation, this teaching plan had been implemented smoothly and has strong feasibility.

This "flipped teaching" adopted online whole-process monitoring, and three time nodes of "on-time online", "middle roll Call" and "on-time end" were included in the statistics. The attendance rate was 94.7%, 94.7% and 100% respectively. One of them failed to go online on time because he was not familiar with the "video conference" software, and one of them asked for leave and went offline because of something during the process. From the statistics of the above three time nodes, whole-process monitoring was helpful to stabilize the teaching attendance rate. It was also conducive to mastering the teaching of emergency, timely discovery, timely treatment. From the perspective of teaching management experience, on-site questioning could motivate the lecturers to prepare for teaching, promote the lecturers to take the initiative to learn, and do a good job of knowledge reserve. The participation of each group of residents in asking questions online could mobilize the active learning consciousness of residents, ensure the coverage and accuracy of the teaching content of the lecturers, and fully mobilize the enthusiasm of teaching and learning. Through the questionnaire star to the teaching quality of 9 indicators feedback, the results showed that the teaching quality was "good" and "very good" accounting for more than 96%. In other specialized clinical training, flipped classroom was also well received and preferred, and it improved teaching satisfaction.[8-10] In terms of the attendance

and teaching quality evaluation of internal medicine residents, the effectiveness of this teaching model was relatively good.

In the overall evaluation of this teaching, 11 internal medicine residents raised praise highlights in 110 questionnaires, accounting for 55.8%. It reflected that the flipped teaching was generally recognized, the opinion which was consistent with other clinical training studies that a flipped classroom approach in physiotherapy education resulted in improved student performances in this professional programme[11]. However, 10 internal medicine residents had no specific feedback among the 69 questionnaires; and 6 internal medicine residents filled in suggestions for improvement in 18 questionnaires, accounting for 9.1%. The above feedback also suggested that the teaching mode still needed to be improved. In promoting the application of this mode. The organizer also needed to follow up the training work in real time, collected the feedback of internal medicine residents, and made continuous improvement based on the requirements of clinical knowledge of the department of infectious diseases in the standardized training of internal medicine residents.

Conclusions and Perspectives

The flipped teaching with video conference as carrier for internal medicine residents participating in the training of the department of infectious diseases was generally effective. The degree of participation and recognition of the trained physicians in this flipped teaching was relatively good, and the implementation of teaching program was feasible. Application of this teaching mode could make up for the shortage of actual training time of residents in a certain stage.

Ethical Approval and Consent to Participate

Informed consents of participants in the standardized training for public health physicians were obtained for the training and the study. All the data received Institutional Review Board (IRB) approval by the Ethics Committee. The IRB number was No. 2021-S026-01.

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Authors' Contributions

Xiao-Yu Zhang made conception, design, acquisition of data, analysis and

interpretation of data; drafted and revised the manuscript; agreed to submit to the current journal; gave final approval of the version to be published; and agreed to be accountable for all aspects of the work.

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Consent for publication

The author has read and agreed to the published version of the manuscript.

Literature share statement

The model included in the manuscript submitted to the journal is transparent. Consent from the corresponding author is required for any institution or individual to reprint this document.

References

[1] Shanghai health and family planning commission,Notice on strengthening standardized training of residents in Shanghai for rotation training of infection department of internal medicine residents[EB/OL]. http://wsjkw.sh.gov.cn/kjjy2/20180815/0012-57913.html

[2] Zhang XY. Rapid Clinical Promotion Model of Standardized Training for Public Health Physicians in China. Adv Med Educ Pract. 2021;12:463-471. doi:10.2147/AMEP.S306737

[3] Hew KF, Lo CK. Flipped classroom improves student learning in health professions education: a meta-analysis. BMC Med Educ. 2018;18(1):38. doi:10.1186/s12909-018-1144-z

[4] Riddell J, Jhun P, Fung CC, et al. Does the Flipped Classroom Improve Learning in Graduate Medical Education?. J Grad Med Educ. 2017;9(4):491-496. doi:10.4300/JGME-D-16-00817.1

[5] Afzal S, Masroor I. Flipped Classroom Model for Teaching Undergraduate Students in Radiology. J Coll Physicians Surg Pak. 2019;29(11):1083-1086. doi:10.29271/jcpsp.2019.11.1083

[6]Wu S, Pan S, Ren Y, et al. Existing contradictions and suggestions: flipped

classroom in radiology courses of musculoskeletal disease under Chinese medical educational mode from medical imaging student perspective. BMC Med Educ. 2020;20(1):75.
doi:10.1186/s12909-020-1991-2
[7] Tang F, Chen C, Zhu Y, et al. Comparison between flipped classroom and lecture-based classroom in ophthalmology clerkship. 2017;22(1):1406198. Med Educ Online. 2017;22(1):1395679.
doi:10.1080/10872981.2017.1395679
[8] Chick RC, Adams AM, Peace KM, et al. Using the Flipped Classroom Model in Surgical Education: Efficacy and Trainee Perception. J Surg Educ. 2021;78(6):1803-1807. doi:10.1016/j.jsurg.2021.05.008
[9] Vanka A, Vanka S, Wali O. Flipped classroom in dental education: A scoping review. Eur J Dent Educ. 2020;24(2):213-226.
doi:10.1111/eje.12487
[10] Lu RY, Yanovitch T, Enyedi L, et al. The flipped-classroom approach to teaching horizontal strabismus in ophthalmology residency: a multicentered randomized controlled study. J AAPOS. 2021;25(3):137.e1-137.e6.
doi:10.1016/j.jaapos.2021.01.008
[11] Røe Y, Rowe M, Ødegaard NB, Sylliaas H, Dahl-Michelsen T. Learning with technology in physiotherapy education: design, implementation and evaluation of a flipped classroom teaching approach. BMC Med Educ. 2019;19(1):291.
doi:10.1186/s12909-019-1728-2