Original Article

Application of microlecture teaching methods in standardized residency training during COVID-19 in Wuhan: a randomized, controlled study

Zhaohong Kong[1,2], Tao Li[1,2], Zhaohui Zhang[1,2], Jian Jiang[1,2], Junhua Mei[3]

[1]Department of Neurology, Renmin Hospital of Wuhan University, Wuhan, China; [2]Department of Neurology, The First Clinical College of Wuhan University, Wuhan, China; [3]Department of Neurology, The First Hospital of Wuhan City, Wuhan, China

Contributions: (I) Conception and design: Z Kong, J Mei, J Jiang; (II) Administrative support: J Jiang, T Li, Z Zhang; (III) Provision of study materials or patients: Z Kong, J Mei, T Li, Z Zhang; (IV) Collection and assembly of data: T Li, J Jiang, J Mei; (V) Data analysis and interpretation: Z Kong, T Li, J Jiang, J Mei; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Junhua Mei, MD, PhD. Department of Neurology, The First Hospital of Wuhan City, Wuhan 430022, China. Email: xiaomeijh@163.com.

Background: Providing high-quality training to residency students during the coronavirus 2019 (COVID-19) pandemic has been a goal of our institution. Since 2108, we began to take microlectures to students teaching. Microlectures are online presentations, and the microlecture teaching method has many advantages, such as a short teaching time, situational resource composition, diverse communication, strong pertinence and can attend microlectures from home. The aim of the present study was to evaluate the advantages of the microlecture teaching method on students in standardized residency training.

Methods: Students from our department were randomly divided into the traditional teaching group (control group) and the microlecture teaching group (observation group). The teaching duration for both groups was 3 months. All students were assessed on basic knowledge of the neurology before enrollment. After the teaching session, the students were assessed on teaching effect, theoretical operation, and clinical practice satisfaction. The students also evaluated the teachers, and the teachers evaluated the students.

Results: A total of 84 students participated in the study and were divided equally into the observation group (42 students) and the control group (42 students). The results showed that the rate of reaching the standard of teaching effect, achievement of theory and operation, satisfaction with clinical practice, the student's grades by teachers, and student satisfaction with teachers were significantly higher in the observation group than in the control group (all $P<0.05$).

Conclusions: The microlecture teaching method can effectively improve the clinical teaching effect for neurology students and should be adopted in clinical teaching, especially during the COVID-19 pandemic.

Keywords: Students; residency; microlecture; teaching method; evaluation

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Introduction

Standardized residency training is characterized by strong practicality, strict standards, professionalism, high requirements, and wide coverage (1). The teaching effect is important to improving the teaching quality and popularity of the institution of Renmin Hospital of Wuhan University among students in standardized residency training. The teaching of neurology requires a wide range of descriptive techniques. Traditional teaching methods involve studies and assessments according to the teaching materials or printed materials at the designated time and place, which introduces many limitations (2,3). If we still adopt the

traditional exam-oriented teaching method, we will get half the result with twice the effort. Therefore, in the present study, we summarize the clinical and teaching experience and refer to foreign teaching methods, such as case-based learning methods (4,5), the Massive Open Online Course method (6), seminar series courses (7), and interactive large-group teaching (8). In the present study, we discuss the application of microlecture teaching methods for medical postgraduates attending standardized residency training at our school, in an attempt to not only improve the teaching quality for these students but to minimize physical contact during the coronavirus disease 2019 (COVID-19) pandemic (9,10).

Microlectures refer to structured digital resources that present fragmented learning content, processes, and extended materials by using information technology. Microlecture teaching is a structured digital teaching method that uses online technology for teaching, courseware, design, and teaching evaluation (11,12). Microlecture teaching has many advantages, such as a short teaching time, diverse communication, and strong pertinence (4,13). We used microlecture teaching methods to teach neurology students at our institution. The results showed that microlecture teaching can effectively mobilize the intelligence and non-intelligence factors of students, such as learning motivation, will, emotion, and interest, and has a satisfactory clinical teaching effect. We present the following article in accordance with the CONSORT reporting checklist (available at http://dx.doi.org/10.21037/apm-21-22).

Methods

Participants

The USA G*Power was used to perform the sample size calculation for the present study. According to a previous study, a sample size of 42 participants in the two groups was required to achieve a type I error of 0.05, with a power of 0.80 in two-group analyses of covariance (ANCOVA) (11). A total of 84 new students in standardized residency training in neurology were selected during the COVID-19 pandemic. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Renmin Hospital, Wuhan University (No. 2018-X-016). Written informed consent was obtained from each participant.

Microlecture design

Establishment of a clinical teaching group

The institutional director of neurology was the group leader, and the deputy director was the deputy group leader and the clinical diagnosis and treatment team leader. Members of teachers consisted of eight clinical physicians. Of them, the leader of the clinical diagnosis and treatment team was mainly responsible for the organization, management, and assessment of training, and the organization of the microlecture. The study is not blinding and the clinical attending physician was responsible for providing an explanation of the related diseases, theoretical knowledge, and operation specifications of each system. The director and deputy group leader of the teaching and the research office were responsible for the inspection and control of results.

Implementation of teaching methods

The teachers recorded videos tailored to the teaching objectives according to the syllabus, as well as the necessary operation skills related to the contents of this round. The key points of teaching and the objectives to be achieved were formulated according to the evaluation results and the clinical practice syllabus. The micro video of the teaching content required by the neurology syllabus was recorded by mobile phone. The sevens teaching themes recorded were as follows: the common symptoms and signs of neurology, peripheral neuropathy, ischemic cerebrovascular disease, hemorrhagic cerebrovascular disease, epilepsy, neurodegenerative disease, and spinal cord disease. Each video lasted 30 minutes, and the video explanation was synchronized with Microsoft Office Power Point (PPT) texts.

A WeChat group was then established as a tool using a mobile app. All students were required to follow the mobile "learn through" app teaching software and to register before class. Teachers set up the teaching courses and classes, and uploaded teaching courseware. Once the teaching commenced, the following steps took place: (I) electronic sign-in: clinical teachers used mobile phone software to send out sign-in instructions (to prevent students from signing in on behalf of others), and students completed the sign-in within the specified timeframe; (II) sharing of training courseware and operation videos: teachers regularly uploaded training courseware and operation videos to the "instant school" for students to refer to at any time; (III)

classroom interaction: students could formulate questions and puzzles, and send them to the training manager at any time through WeChat, and the manager could organize discussions or designate relevant clinical experts to answer them; (IV) computer-assisted classroom statistics: course learning, course examination, and finally, task examination, were put in place. After the course, the system automatically recorded the training and learning situation.

In practice, within the control group, the traditional teaching method was adopted with the teacher as the leader. The teacher prepared the lesson according to the syllabus at hand; having understood the teaching content, the students prepared for the lesson independently before the class. The teacher gave the lesson based on the analysis of the diseases and conditions of individual patients and asked the students questions about the cases. The teacher provided comments on the answers given by the students. The teaching content in the traditional teaching group was the same as that in the observation group and was based on the syllabus.

Evaluation method

Similar to evaluation methods used in previous research (14,15), Questionnaire Star, an online survey, was sent via WeChat immediately after the training, and students completed the evaluation questionnaire on the spot. Using Questionnaire Star online software to edit the materials and the evaluation results, which can be automatically analyzed.

Onsite training assessment

Using Xuxitong Learning software (www.xuexito.com), students could complete paperless assessments in the same place and at the same time. The assessment was carried out in the form of the "instant school" system, with test papers randomly generated to avoid plagiarism. After the assessment, scores were automatically generated, and analyses of the results and accuracy were released in real time. The content was mainly based on the "neurology volume of clinical practice outline" of Wuhan University, which was divided into basic knowledge and clinical skill examination, and a unified examination form and unified standard answer. The theory examination was in the form of closed papers and unified marking.

Evaluation of teaching effect

The main indicators included the actual teaching effect, which took into account the teaching relevance (20 points), practicality (20 points), enlightenment (15 points), teaching form (15 points), and teaching effect (30 points). The maximum score was 100 points, and 60 points was considered satisfactory.

Survey of students' teaching satisfaction

The content included an evaluation of whether the teaching effect, content, and methods were satisfactory. There were four grading scales: poor, medium, good, and excellent (10, 20, 30, and 40 points, respectively), and each item graded individually. The total score was finally calculated.

Evaluation of interns by the teachers

The evaluation mainly took into consideration the teaching effect in students based on six items as follows: (I) clinical adaptability (10 points); (II) theoretical knowledge mastery (30 points); (III) ability to understand and apply knowledge (15 points); (IV) independent learning ability and attitude (10 points); (V) clinical skills (20 points); and (VI) innovation and problem solving (15 points). The maximum score was 100 points.

Statistical analysis

Data were analyzed with SPSS version 19.0 statistical software (IBM, Armonk, NY, USA). Measurement data with normal distribution were expressed as mean ± standard deviation (SD), and measurement data with skewed distribution were expressed as median (Q1, Q3). The χ^2 test was used to compare count data, and the *t*-test was used to compare measurement data between groups. $P<0.05$ was considered to be statistically significant.

Results

Comparison of theoretical and operational assessment scores of the groups before and after enrollment

The ages of interns in the two groups ranged between 21 and 35 years, with an average of age of 25.2±3.05 years. There were 25 males and 17 females in the control group, with an average age of 25.1±3.67 years, and 23 males and 19 females in the observation group, with an average age of 25.7±4.03 years. All students had previously completed basic teaching courses of clinical medicine and basic medicine as regular courses.

No statistically significant difference was found between the groups before admission in terms of the results of theory and clinical operation skills examinations. The statistical

Table 1 Comparison of theoretical and operational assessment results between the two groups of interns (score, mean ± SD)

Group	Theory			Operation		
	Before enrollment	After enrollment	P value	Before enrollment	After enrollment	P value
Control group	63.66±5.72	78.21±5.26	0.020	68.92±5.15	80.26±5.90	0.032
Observation group	63.06±5.90	90.62±5.37	0.018	67.93±4.92	92.88±6.82	0.039
P value	0.076	0.036		0.289	0.028	

SD, standard deviation.

Table 2 Evaluation of the teaching effect in the two groups of students (mean ± SD)

Group	Relevance (20 points)	Practicality (20 points)	Enlightenment (15 points)	Teaching form (15 points)	Teaching effect (30 points)	Total score (100 points)
Control group	18.31±3.83	17.13±2.96	11.25±1.91	10.21±4.27	13.9±3.74	73.25±4.21
Observation group	18.50±3.21	19.80±2.07	15.07±4.20	14.65±4.15	18.22±3.52	88.69±4.32
P value	0.164	0.057	0.028	0.032	0.037	0.003

SD, standard deviation.

results of the theoretical and clinical performances of the two groups showed that the scores before graduation were significantly higher than those before admission. The results also indicated that the scores of the observation group were significantly higher than those of the control group (P=0.036 and P=0.028, respectively), especially for clinical operation skills (*Table 1*).

Evaluation of teaching effect in the two groups of interns

The results showed that there was no significant difference between the observation group and the traditional teaching group in terms of teaching practice and relevance (P=0.058 and P=0.165, respectively). For teaching form and teaching inspiration, the score of the observation group was significantly higher than that of the control group (P=0.031 and P=0.017, respectively). In terms of the actual teaching effect, the score of the observation group was significantly higher than that of the control group (P=0.036). The score of the observation group was also significantly higher than that of the control group (P=0.002). This further suggested that our microlecture teaching method has the advantages of practicality and relevance over traditional teaching, and it overcomes the shortcomings of traditional teaching, such as the single form, rigid content, and limited practical teaching effect. Such an advantageous method is worth further promotion (*Table 2*).

Survey of students' teaching satisfaction

The results showed that there was no significant difference between the groups in terms of teaching content (P=0.078), which may be related to teachers' performance according to the syllabus. There were significant differences in teaching methods, teaching effects, and self-evaluation between the two groups. The scores of the observation group were significantly higher than those of the control group (P=0.034, P=0.028, and P=0.035, respectively). The total scores for satisfaction in the observation group were significantly higher than that those of the control group (P=0.005). These results showed that, compared with the traditional teaching method, the micro-curriculum teaching method has similar teaching content, but has more obvious advantages in teaching methods, effects, and students' self-evaluation (*Table 3*).

Evaluation of interns by the teachers

The evaluation focused mainly on students' satisfaction with their teachers in terms of teaching content and teaching objectives. The results showed that there were significant differences between the two groups in the evaluation of students' clinical adaptability, mastery of basic theoretical knowledge, understanding and application of knowledge, attitudes toward and ability to adapt to autonomous learning, clinical skills, practical problem-solving, and

Table 3 Survey of students' satisfaction with the teaching (mean ± SD)

Group	Teaching method	Content	Effect	Self evaluation	Total score
Control group	25.27±4.32	33.77±3.51	28.33±3.78	31.31±4.27	117.15 ±8.09
Observation group	35.69±3.48	34.73±3.67	37.25±3.24	38.37±4.35	145.79±8.31
P value	0.034	0.078	0.028	0.035	0.005

SD, standard deviation.

Table 4 Evaluation of interns by the teachers (mean ± SD)

Project	Control group	Observation group	P value
Clinical adaptation (10 points)	7.31±2.90	9.34±1.27	0.037
Theory knowledge (30 points)	20.14±2.72	25.43±3.67	0.015
Knowledge understanding and applying (15 points)	10.02±2.78	13.93±2.43	0.036
Self-learning (10 points)	6.37±2.06	8.05±3.17	0.021
Clinical skills (20 points)	14.98±1.81	18.78±2.93	0.026
Solve problems (15 points)	10.80±5.12	13.19±4.14	0.018
Total score (100 points)	75.49±7.48	90.07±8.36	0.002

SD, standard deviation.

innovation ability. The scores of the observation group were significantly higher than the control group. This showed that, compared with the traditional teaching methods, the microlecture teaching method not only improves student satisfaction, but also improves teacher satisfaction with the interns, which promotes positive interaction between teachers and their students (*Table 4*).

Discussion

Clinical teaching is the core of the medical teaching, and it is an important stage of training. Through clinical practice, students can systematically master various clinical skills, combine theoretical knowledge with practice, and gradually transition from textbook learning to patient and clinical practice (14,16). In recent years, some studies have shown that the overall trend of the medical education at home and abroad; therefore, it is urgent to explore new modes of education (17,18).

The microlecture teaching approach adopted in the present study integrated modern educational resources and overcame the emptiness of the "cramming" teaching in the past, which encouraged positive interaction between students and teachers. The teaching plan was carefully prepared by a number of experienced teachers. Video teaching provides students with a deep intuitive experience, and the teaching effect was maximized.

The microlecture teaching method is conducive to improving students' theoretical and clinical operation skills. Clinical medicine is a discipline with a wide range of knowledge, strong professionalism, and high requirements for practice. If the traditional teaching "cramming" mode is adopted to let students learn passively, it will not only restrict students' individual thinking, but will also restrict their individual development and inspiration for creative thinking. The results of the present study showed that the scores of the two groups before graduation were significantly higher than their scores before admission. However, upon further comparison, the score of the observation group was significantly higher than that of the control group (P=0.035 and P=0.018, respectively); this was particularly significant for the clinical operation skills score. This may be related to the core goal of microlectures is to make learning more personable, more flexible in meeting the needs of learners, and stimulating in terms of autonomous learning. Its basic characteristics include diversification of form, conciseness of content, emphasis on teaching design, focus on ubiquitous learning, and breakthroughs in limitations of time, space, and funds. As opposed to traditional theory-instilling teaching, the microlecture transforms the "teachers want

me to learn" attitude into "I want to learn".

The microlecture teaching method is important for the learning effect. The results of the present study showed that there was no significant difference between the microlecture teaching method and the traditional teaching method in terms of practice or relevance; the microlecture method had the advantages of practice and relevance with traditional teaching, which were conducive to putting the current syllabus into practice. However, the micro-curriculum teaching method had significantly higher teaching effect than the control group in the teaching form, the inspiration of teaching, the actual teaching effect and the total score group. This further suggests that the micro-curriculum teaching method can overcome the shortcomings of the traditional teaching method, including the lack of inspiration, and limited practical teaching effect. This may be related to the fact that the fragmented course was a major advantage of micro-course teaching. The duration of micro-course teaching was relatively short. Each micro-video was recorded within 10 minutes, as staff had other work and family commitments, and their time was limited (11,12). The 10-minute fragmented teaching video of was suitable for the interns to study at any time and place, and could be watched repeatedly. For the more complicated parts of the lecture could be repeated, which facilitated the process of independent learning (19). At the same time, the backstage statistical table of the "instant school" used in this method can hold the progress and completion of students' learning assessment in real time, and further help to improve the actual teaching effect.

The microlecture is beneficial for improving students' teaching satisfaction. We evaluated student satisfaction with regard to teaching effect, content, and method. The results showed that there was no significant difference between the two groups in terms of teaching content (P=0.078), which may be related to all teaching content being delivered according to the syllabus. However, there were significant differences between the two groups in terms of teaching methods, teaching effects, and self-evaluation. The scores of the observation group were significantly higher than those of the control group (P=0.032, P=0.018, and P=0.026, respectively). The "instant school" background statistical table used in the micro-course teaching method can hold the real-time evaluation of students' teaching effect on the lecturer. It can also be used for feedback, which is sent to the manager through the app, so that the instructor has more time to identify the deficiencies in the teaching process with the help of the training effect evaluation form completed by the students. The instructor can then analyze and improve the process. At the same time, the students can use the mobile app to consolidate the knowledge they have acquired and promote their short-term memory to long-term memory (20-22). In addition, the adoption of "1 computer background Internet" of 3 terminals (student mobile terminal, teacher mobile terminal, teaching projection terminal) is conducive to the enthusiasm of students and inspiration of students' initiative and thinking. Compared with the traditional teaching methods, the micro-curriculum teaching method has similar teaching content, but offers clear advantages in terms of teaching methods, effects, and student self-evaluation.

Finally, our results showed that the new method helps to improve students' satisfaction with teachers. Students and teachers interact in the teaching process. Traditional teaching methods emphasize the central role of teachers in teaching but ignore the importance of student participation in the teaching process. As mentioned, our research found that the micro-class teaching method can effectively improve teachers' satisfaction with the students they teach, but its effect on students' satisfaction with teachers warrants further investigation. A previously published study looked at students' clinical adaptability, theoretical knowledge mastery, independent learning ability and attitude, clinical skills, innovation ability, and problem-solving ability, as well as their ability to understand and apply knowledge (5). The results of the present study showed that there were significant differences between the two groups in terms of evaluation of students' clinical adaptability, mastery of basic theoretical knowledge, understanding and application of knowledge, attitude and ability for autonomous learning, clinical skills, and practical problem-solving, as well as innovation ability. The scores of the observation group were significantly higher than those of the control group. Therefore, compared with the traditional teaching method, the micro-curriculum teaching method not only increases student satisfaction, but also enhances the satisfaction of teachers with the interns, which is more conducive to positive teacher-student interaction. This could be related to the "immediate school" used in this method, which can give real-time feedback to the satisfaction of teachers and students in the teaching process; consequently, teachers have more time to find inadequacies in the teaching process according to the effect evaluation form completed by students and to make timely improvements. This can achieve positive interactions and satisfactory results. In the present case, students were satisfied with the teaching effect,

with the learning effect increased with teachers' satisfaction and the teaching process itself would also increase. However, as a new teaching method, the microlecture teaching method may be a novel idea to both students and teachers.

Despite these advantages, it is worth noting that this study has some shortcomings, as does the microlecture teaching method. The teachers were not blinded to the intervention, which may affect the credibility of the findings. When learning with videos and PPTs on a mobile phone, we must use WiFi. However, at present, the coverage and security of public WiFi are insufficient. Some college students may only use mobile traffic to learn, which increases the economic cost to the student. The training content was also limited. The PPT on the "instant school" and the video was generally less than 10 minutes. Finally, it was difficult to control the teaching process, as students may stray on to unrelated Internet pages or social media during their classes, or they may fail to participate in group discussions actively. However, the microlecture teaching method is a new method, we will continue to improve the method to more suitable to get a clinical component.

Conclusions

The process of the microlecture teaching is not only a cognitive activity, but also an emotional activity process. Compared with the traditional teaching method, the microlecture teaching method is conducive to improving the theoretical and clinical operation skills of students. It is also conducive to improving the teaching satisfaction of students and teachers. There are advantages and disadvantages in using the microlecture teaching method and these should be considered. However, as a new product of Internet teaching, this method can improve the teaching effect and learning ability of students, while effectively improving the knowledge level and clinical ability of the doctors. Therefore, this method is worth popularizing and applying.

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Footnote

Reporting Checklist: The authors have completed the CONSORT reporting checklist. Available at http://dx.doi.org/10.21037/apm-21-22

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