Comparison of Rain Classroom Teaching and Traditional Teaching Methods in Teaching Undergraduate Nursing Students of Stomatology

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Research Article

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Abstract

Background: Rain classroom teaching (RCT) is now used as a teaching method to increase interaction between teachers and students. The aim of this paper is to [investigate](#) the influence of rain classroom teaching and traditional teaching on self-directed learning ability (SDLA) of nursing undergraduates.

Methods: This was a randomized controlled study. The research enrolled two classes of junior nursing undergraduates, they were randomly divided into two groups. The content and time of Stomatology courses were the same. The control group (n=32) adopted traditional teaching method and the experimental group (n=31) used RCT method. SDLA, satisfaction and teaching quality were evaluated by questionnaire. A final examination was used to estimate the quality of learning.

Results: The complete data displayed that rain classroom group had more excellent results than the traditional group. The rain classroom group had higher SDLA, satisfaction, teaching measure, teaching effectiveness and final examination scores.

Conclusion: Rain classroom teaching method is more effective than traditional teaching method in promoting SDLA and teaching quality for undergraduate nursing students in stomatology.

Background

Stomatology is a complex subject for nursing undergraduates, because it is strong professional and less in class hours, and all nursing undergraduates are supposed to study stomatology in order to reserve knowledge for future. Compared with other internal medicine and surgery courses, stomatology has fewer class hours and lays more emphasis on practice, which puts forward higher teaching requirements for theoretical teaching of stomatology. Although student-centered traditional teaching is widely used in teaching, it is easy to lead to passive learning[[i]]. Self-directed learning (SDL) is a effective strategy to promote students' lifelong learning[[ii]]. Medical students need to develop self-directed learning ability (SDLA) to adapt to the changing technology[[iii]]. Therefore, new teaching methods should be applied in the teaching of stomatology to improve students' learning interest and SDLA.

Teachers play a dominant role in traditional teaching, with teachers lecturing and students listening. The theoretical content of stomatology is boring and abstract, which is difficult to comprehend and students can't concentrate all the time. The boring teaching content and old teaching methods will lead to the decrease of students' learning enthusiasm. Recently, a variety of teaching methods have emerged, such as CBL, PBL, flipped classroom, rain classroom, etc., all of which have achieved good teaching results[[iv]-[v][vi]].

Rain classroom is a teaching software and a small plug-in cut in PPT. Online Education Office of Tsinghua University and the Xuetang Online jointly developed this software. With the help of WeChat, it realizes the interaction with students before, during and after class, which improves students' learning interest and enlivens the classroom atmosphere. Using rain class, we can make single choice questions, multiple-choice questions, voting questions, inserting MOOCs, etc. in PPT, and we can also make preview courseware, upload review materials and exercises after class to rain class. In class, exercises, voting, barrage and random roll call can be used to increase classroom interaction and arouse students' enthusiasm. At the same time, class courseware is synchronized to students' mobile phone for easy learning and review. At present, it has been widely used in colleges and universities.

In this study, rain classroom teaching had been used in teaching undergraduate nursing students of stomatology. The teaching effect had been measured through questionnaire survey and final examination results.

[i]. Mazur E. Education. Farewell, lecture? Science. 2009 Jan 2;323(5910):50-1. doi: 10.1126/science.1168927. PMID: 19119207.

[ii]. Naeimi L, Abbaszadeh M, Mirzazadeh A, Sima AR, Nedjat S, Mortaz Hejri S. Validating Self-Reflection and Insight Scale to Measure readiness for Self-Regulated Learning. J Educ Health Promot. 2019 Aug 30;8:150. doi: 10.4103/jehp.jehp_101_19. PMID: 31544115; PMCID: PMC6745879.

- [iii]. Premkumar K, Vinod E, Sathishkumar S, Pulimood AB, Umaefulam V, Prasanna Samuel P, John TA. Self-directed learning readiness of Indian medical students: a mixed method study. *BMC Med Educ*. 2018 Jun 8;18(1):134. doi: 10.1186/s12909-018-1244-9. PMID: 29884155; PMCID: PMC5994133.
- [iv]. Bi M, Zhao Z, Yang J, Wang Y. Comparison of case-based learning and traditional method in teaching postgraduate students of medical oncology. *Med Teach*. 2019 Oct;41(10):1124-1128. doi: 10.1080/0142159X.2019.1617414. Epub 2019 Jun 19. PMID: 31215320.
- [v]. Hwang LL. Educational Intervention on Undergraduate Cancer Awareness and Self-Directed Learning. *J Cancer Educ*. 2018 Jun;33(3):592-601. doi: 10.1007/s13187-017-1210-y. PMID: 28315145.
- [vi]. Ramnanan CJ, Pound LD. Advances in medical education and practice: student perceptions of the flipped classroom. *Adv Med Educ Pract*. 2017 Jan 13;8:63-73. doi: 10.2147/AMEPS109037. PMID: 28144171; PMCID: PMC5245805.

Methods

Participants

A total of 63 junior nursing undergraduates from China Medical University were recruited as research subjects. The Ethics Committee of Stomatological Hospital affiliated to China Medical University authorized this study in 2019. Two classes were divided into experimental and control group by lottery. The experimental group, namely rain classroom teaching group, consisted of 31 students, including 1 male and 30 female. The average age was 21.23 ± 0.76 years old. The control group consisted of 32 females and average age was 21.00 ± 0.76 years old. All participants participated in the study voluntarily. The teaching content of stomatology was the same for students in the two classes. The students of the two classes didn't live in the same dormitory. The learning methods of the two groups of subjects were not contaminated. Differences with regard to the general demographic data of the two groups were not significant ($p > 0.05$).

Design

The teaching content included oral and dental anatomy, oral and maxillofacial anatomy, dental pulp, cleft lip and palate, oral and facial infection and oral tumor care, etc. Control group adopted the traditional teaching method, with priority given to teaching. Students listened and took notes. At the end of teaching, the teachers summarized the course and assigned homework. The whole teaching course reflected the fact that the teachers were the center of the learning environment, while the students were the passive learners and knowledge container. The teachers in the two groups were the same, and each lesson lasted for 45 minutes. The total number of the theoretical lessons was 20, lasting 2 months.

Rain classroom teaching was adopted in the experimental group. Rain class is a small plug-in for cutting in PPT. After downloading the rain class program from the teacher's computer, the teacher could make single-choice questions, multiple-choice questions and voting questions in PPT. Before class, teachers made rain courseware, including preview courseware, teaching courseware and review of expansion materials. The teacher paid attention to the official account of rain class in WeChat, and set up courses and classes in the rain classroom, in this way, pre-school materials and after-school development exercises could be sent to mobile phones. In the classroom, the teacher logged in the rain classroom courseware with the function of wechat, displayed the "start teaching" two-dimensional code, and the students entered the classroom by scanning the QR code on wechat, so that the teacher could master the students' arrival situation. In class, Using the function of random roll call, the teacher asked the key teaching contents randomly, each student had the possibility of being selected, so to a certain extent, it mobilized the enthusiasm of students. In order to concentrate the students' attention, the teacher carried out a classroom test of 1-2 questions every few knowledge points. The teacher could view the test results of students in real time and displayed the test results on the screen, which was conducive to students' mastering the overall answering situation and adjusting their attention and learning methods in time. Students could also send questions to the teacher at any time through the barrage or contribution, and the teacher would explain or answer questions according to the students' situation. In the teaching process, the teacher's ppt was synchronized to the student's mobile phone, students might click to collect and pay

attention to the content they don't understand, which was convenient for review and consolidation in the future. After class, teachers released review and expansion materials, including exercises, MOOCS, literature, etc., to consolidate the classroom content, make up for the lack of class time, and expand the teaching content. Teachers could see the preview, review and class situation of students in the background of rain class. For students who had not prepared and reviewed in time, teachers could issue announcements to remind students. Students could preview and review anytime and anywhere on the mobile phone. Compared with paper learning materials, rain classroom was more convenient. Students' classroom learning could form a learning report after class, which was conducive to teachers' mastery of students' overall learning situation, targeted teaching and continuous improvement of teaching methods. The teaching time of each course was 45 minutes, the total number of theoretical lessons was 20, lasting 2 months.

Effectiveness evaluation

The teaching effect of the two teaching methods was assessed in the form of questionnaire and final examination. The questionnaire included self-made self-directed learning instrument, teaching quality evaluation and the teaching satisfaction questionnaire. Questionnaires on SDLA were distributed ahead of the first course. At the end of the course, questionnaires on teaching quality evaluation, satisfaction and SDLA were carried out. SDLA questionnaire contained 6 subscales: learning motivation (10 items, scores 10 to 50), learning method (14 items, scores 14-70 points), learning behavior (13 items, scores 13-65), time management (3 items, scores 3 to 15), environment management (4 items, scores 4-20), the social dimension (8 items, scores 8 to 40), with a total of 52 items. Every one had a 5-point Likert-type option ranging from “strongly disagree” to “strongly agree”. The highest total score was 260 and the lowest score is 52. The higher total score meant stronger SDLA. Teaching quality evaluation scale contained 5 subscales, with a total of 26 items. 5-point Likert-type scale was adopted for each item, ranging from very dissatisfied to very satisfied. The satisfaction questionnaire had 1 item, with the response categories from 1(very satisfied) to 5(very dissatisfied). The teaching satisfaction score was the sum of students' satisfaction score/the total number of students (full score was 5). 2 weeks after the end of the semester, a theory test was conducted, with a full mark of 100. The content of the test was the theoretical teaching content, the question type included single choice, right/wrong judgment, English-Chinese translation, short answer questions, fill-in-blank questions, and concept questions. The test was reviewed by the same teacher who had taught students.

Statistical analysis

All data were analyzed by SPSS version13.0 software. The data showed in this study were in the form of standard deviation of mean. Independent sample test was carried out to test SDLA scores, examination scores, teaching quality scores and satisfaction. $p < 0.05$ was regarded as statistical difference.

Results

Demographic data of the two subjects.

Demographic data of the two subjects is as follows. See Table 1.

Table 1. Demographic of the two groups.

Variable	Control group (n = 32) N(%)	Experimental group (n = 31) N(%)
Sex		
Male	0	1(3.2)
Female	32(100)	30(96.8)
Age(years),mean(SD)	21.00(0.76)	21.23(0.76)
Community		
Rural	18(56.3)	15(48.4)
Urban	14(43.7)	16(51.6)
Student leader		
Yes	13(40.6)	13(41.9)
No	19(59.4)	18(58.1)
The chief way to learn		
Internet	4(12.5)	8(25.8)
Textbook	27(84.4)	20(64.5)
Library or other	1(3.1)	3(9.7)
Reasons for choosing nursing science		
Personal reasons	26(81.2)	18(58.1)
Parents' reasons	2(6.3)	9(29)
others	4(12.5)	4(12.9)
Mother's highest level of education		
High school and below	27(84.4)	25(80.6)
College and above	5(15.6)	6(19.4)
Father's highest level of education		
High school and below	26(81.2)	22(71.0)
College and above	6(18.8)	9(29.0)
Truancy experience		
Yes	11(34.4)	11(35.5)
No	21(65.6)	20(64.5)

Comparison of SDLA between the two subjects.

The initial SDLA scores of the two subjects had no significant difference. ($p>0.05$), the data were shown in Table 2. The experimental group's total score of SDLA, scores of learning motivation, learning methods and learning behavior dimensions were higher than the control group with statistical significance ($p<0.05$). The SDLA scores are shown in Table 3.

Table 2. Comparison of self-directed learning ability between the two groups before class (score, $\bar{x} \pm s$)

Group	learning motivation	learning methods	Learning behavior	time management	Environmental management	Sociality	Total score
Control group (n=32)	32.81±3.69	53.69±5.40	43.91±3.32	11.56±1.63	16.78±2.04	31.88±4.05	190.63±15.50
Experimental group (n=31)	34.29±4.63	53.45±7.27	43.71±4.64	11.16±2.40	16.23±2.73	31.42±4.49	190.26±22.28
t	-1.403	0.147	0.194	0.780	0.916	0.423	0.076
p	0.166	0.884	0.847	0.438	0.363	0.674	0.940

Table 3. Comparison of self-directed learning ability between the two groups at end of course (score, $\bar{x} \pm s$)

Group	Learning motivation	Learning methods	Learning behavior	Time management	Environmental management	Sociality	Total score
Control group (n=32)	34.56±3.99	53.53±4.86	44.75±4.04	11.56±1.59	15.91±1.89	31.78±4.56	192.34±15.94
Experimental group (n=31)	36.71±4.00	56.74±5.29	47.97±4.63	12.26±1.13	16.45±1.59	33.06±2.50	203.19±12.28
t	-2.130	-2.511	-2.942	-2.003	-1.238	-1.379	-3.020
p	0.037	0.015	0.005	0.050	0.220	0.173	0.004

Comparison of teaching quality between the two subjects.

The scores of teaching measure and teaching effectiveness of traditional teaching group were significantly lower than those of rain classroom group ($p < 0.05$). The total score of teaching quality in the traditional teaching group was also lower than the rain classroom group, as is shown Table 4.

Table 4. Comparison of teaching quality between the two groups (score, $\bar{x} \pm s$)

Group	Professional quality	Teaching attitude	teaching measure	Teaching ability	teaching effectiveness	Total score
Control group (n=32)	22.69±3.04	18.13±2.15	17.28±2.45	36.53±4.49	21.41±2.51	116.03±13.58
Experimental group (n=31)	22.77±4.10	18.74±1.90	18.55±2.23	37.48±4.03	23.35±2.48	121.42±11.56
T value	0.096	-1.206	-2.142	-0.885	-3.095	-1.693
P value	0.924	0.233	0.036	0.379	0.003	0.096

Comparison of the satisfaction and test score between the two subjects.

The traditional teaching group's satisfaction was lower than the rain classroom group, while there were no statistical difference($p>0.05$) . Final examination scores of the experimental group were also higher than the control group ($p<0.05$).See Table 5.

Table 5. Comparison of the two groups' satisfaction with the course and examination scores (score, $\bar{x} \pm s$).

Item	Control group (n=32)	Experimental group (n=31)	T value	P value
Satisfaction	4.34±0.653	4.61±0.667	-1.618	0.111
Examination score	75.56±7.86	80.03±7.68	-2.282	0.026

Discussion

Rain classroom is jointly researched by Xuetao online and Online Education Office of Tsinghua University. It was officially open to the public free of charge in April 2016. Rain classroom is a hybrid teaching software based on PowerPoint and WeChat. It helps to connect teachers and students smoothly through internet. Rain classroom combines PowerPoint and WeChat perfectly with complex information technology. Rain class enables teachers and students to establish interaction and connection before, during and after class. Pre-class preview courseware, such as MOOC video, exercise and voice can be pushed to students' mobile phones. Teachers can arrange preview tasks, understand students' Preview situation, make targeted teaching preparation. In class, real-time question answering, bullet screen interaction and random roll call can improve students' learning enthusiasm. Students receive PPT and test questions in real time on the mobile terminal, and can feed back the knowledge points they don't understand to the teachers through the "don't understand" button, which is conducive to the teachers to timely grasp the students' learning status and make targeted explanation. After class, the teacher will have MOOC After class review courseware of video, and exercise and voice are pushed to students' mobile phones to arrange review tasks after class, expand frontier knowledge of disciplines and broaden students' vision. Curriculum reform in Colleges is committed to increasing the interaction between teachers and students ,improving students' self directed learning[[i]],while rain classroom can help a lot.

Compared with digital resources, students tend to review with digital resources, especially two weeks before the exam[[ii]]. Information and internet develop so fast, various social networks have emerged and dominated at different stage (ie, QQ, micro-blog, WeChat, Tiktok).Social software has greatly influenced college students' behavior, playing an increasingly irreplaceable role in college students' life or learning. WeChat is the most popular social media platform in China[[iii]] and also the main social software used by Chinese college students[[iv]]. WeChat has many functions, not only for social intercourse, but also for health education [[v]-[vi][vii]] and teaching[7,[viii]]. Educational reforms should be carried out integrating social media[[ix]],and the combination of WeChat and software program is well applied in teaching which help facilitating students' self directed learning ability[[x]]. Rain classroom has established a seamless connection between teachers and students, it makes up for the lack of class time, students can control over learning hours, place, and learning progress via WeChat and internet. In rain class, preview materials and preview questions are released before class. During class, courseware is synchronized to the mobile terminal, and random roll call and interactive online answers are carried out. After class, development materials and review questions are released to enable students to prepare before class. In class, teachers explain and synchronize exercises to deepen their understanding of knowledge and skills. After class, frontier knowledge can be expanded and knowledge learned can be consolidated. Teachers can support students' participatory learning by providing guiding support and learning conditions[[xi]].

The means of SDLA is that individuals make use of all learning resources, determine learning objectives, formulate learning methods, and evaluate learning effects. It is active, whether with or without help from others[[xii]]. Nursing has made great efforts to explore SDL readiness from the mid-1980s to 1998[[xiii]]. SDLA has been regarded as an important ability in nurses' professional career [[xiv]]. The complexity of patients' condition and the speed of updating medical knowledge require nurses to have the ability of self-directed learning [[xv]-[xvi][xvii]]. Nursing students should develop self-directed learning ability in school. Rain classroom teaching mode is conducive to the improvement of self-directed learning ability. Rain classroom provides

students with digital learning resources, and learning is not limited by time and place. In this study, the rain classroom teaching group's self-directed learning ability had been greatly improved, and students' final exam scores were significantly higher than the traditional teaching group. Some researcher had proved that higher self directed learning ability had a positive impact on academic results[[xviii]-[xix]]. The satisfaction scores of the two groups had no significant difference, but the scores of teaching effect and teaching measure dimensions in rain classroom group were significantly higher than those of the traditional teaching group($p<0.05$). While the ability of self directed learning is correlated with personal characteristics and demography[[xx]], teachers should adopt individualized teaching methods. Rain classroom teaching arouses the enthusiasm of students and learning enthusiasm, so it achieves good teaching effect. At the same time, rain classroom teaching requires students to have sufficient mobile phone power, fast and stable network speed to ensure effective interaction with teachers. The enlightenment to managers and educators is to reasonably configure power sockets and improve network speed.

This study has some limitations as folowings. Firstly, there was no large sample size and multicenter large sample study hasn't been included, and the impact of large sample studies on the results is not known. Secondly, the course lasted for two months. We only observed the short-term teaching effect, but the long-term influence of rain classroom teaching on students' self-directed learning ability is not clear. Finally, because the teachers engaged in stomatology teaching are clinical teachers, who are busy and whose time is limited, there is no qualitative interview on rain classroom teaching. We only carried out questionnaire investigation and final examination to evaluate the two teaching methods' teaching quality. How rain classroom works to promote students' self-directed learning ability is unknown.

[i]. Alharbi HA. Readiness for self-directed learning: How bridging and traditional nursing students differs? *Nurse Educ Today*. 2018 Feb;61:231-234. doi: 10.1016/j.nedt.2017.12.002. Epub 2017 Dec 11. PMID: 29248841.

[ii]. Scott K, Morris A, Marais B. Medical student use of digital learning resources. *Clin Teach*. 2018 Feb;15(1):29-33. doi: 10.1111/tct.12630. Epub 2017 Mar 16. PMID: 28300343.

[iii]. Zhang X, Wen D, Liang J, Lei J. How the public uses social media wechat to obtain health information in china: a survey study. *BMC Med Inform Decis Mak*. 2017 Jul 5;17(Suppl 2):66. doi: 10.1186/s12911-017-0470-0. PMID: 28699549; PMCID: PMC5506568.

[iv]. Zeng F, Deng G, Wang Z, Liu L. WeChat: a new clinical teaching tool for problem-based learning. *Int J Med Educ*. 2016 Apr 25;7:119-21. doi: 10.5116/ijme.5708.e5c4. PMID: 27111920; PMCID: PMC4844534.

[v]. Ma D, Cheng K, Ding P, Li H, Wang P. Self-management of peripherally inserted central catheters after patient discharge via the WeChat smartphone application: A systematic review and meta-analysis. *PLoS One*. 2018 Aug 28;13(8):e0202326. doi: 10.1371/journal.pone.0202326. PMID: 30153253; PMCID: PMC6112638.

[vi]. Wu Q, Huang Y, van Velthoven MH, Wang W, Chang S, Zhang Y. The effectiveness of using a WeChat account to improve exclusive breastfeeding in Huzhu County Qinghai Province, China: protocol for a randomized control trial. *BMC Public Health*. 2019 Dec 2;19(1):1603. doi: 10.1186/s12889-019-7676-2. PMID: 31791295; PMCID: PMC6889429.

[vii]. Zhang F, Yuen LW, Ding L, Newman IM, Shell DF. Pilot Study of a Brief WeChat Intervention in China to Increase Students' Willingness to Assist a Flushing Student to Reduce Alcohol Use. *J Prev Med Public Health*. 2018 Nov;51(6):320-325. doi: 10.3961/jpmph.18.127. Epub 2018 Nov 7. PMID: 30514062; PMCID: PMC6283739.

[viii]. Zhang W, Li ZR, Li Z. WeChat as a Platform for Problem-Based Learning in a Dental Practical Clerkship: Feasibility Study. *J Med Internet Res*. 2019 Mar 19;21(3):e12127. doi: 10.2196/12127. PMID: 30888328; PMCID: PMC6444215.

[ix]. Guraya SY, Al-Qahtani MF, Bilal B, Guraya SS, Almaramhy H. Comparing the extent and pattern of use of social networking sites by medical and non medical university students: a multi-center study. *Psychol Res Behav Manag*. 2019 Jul 29;12:575-584. doi: 10.2147/PRBM.S204389. PMID: 31534376; PMCID: PMC6681135.

- [x]. Liu T, Luo J, He H, Zheng J, Zhao J, Li K. History-taking instruction for baccalaureate nursing students by virtual patient training: A retrospective study. *Nurse Educ Today*. 2018 Dec;71:97-104. doi: 10.1016/j.nedt.2018.09.014. Epub 2018 Sep 25. PMID: 30268075.
- [xi]. Domen J, Hornstra L, Weijers D, van der Veen I, Peetsma T. Differentiated need support by teachers: Student-specific provision of autonomy and structure and relations with student motivation. *Br J Educ Psychol*. 2020 May;90(2):403-423. doi: 10.1111/bjep.12302. Epub 2019 Jul 2. PMID: 31267512; PMCID: PMC7318603.
- [xii]. Knowles M. Self-directed learning: a guide for learners and teachers. New York: Associated Press. 1975
- [xiii]. Slater CE, Cusick A. Factors related to self-directed learning readiness of students in health professional programs: A scoping review. *Nurse Educ Today*. 2017 May;52:28-33. doi: 10.1016/j.nedt.2017.02.011. Epub 2017 Feb 14. PMID: 28229917.
- [xiv]. Cheng SF, Lee-Hsieh J, Turton MA, Lin KC. Validation of self-directed learning instrument and establishment of normative data for nursing students in taiwan: using polytomous item response theory. *J Nurs Res*. 2014 Jun;22(2):90-100. doi: 10.1097/JNR.0000000000000027. PMID: 24821416.
- [xv]. Cadorin L, Rei A, Dante A, Bulfone T, Viera G, Palese A. Enhancing self-directed learning among Italian nursing students: A pre- and post-intervention study. *Nurse Educ Today*. 2015 Jun;35(6):746-53. doi: 10.1016/j.nedt.2015.02.004. Epub 2015 Feb 18. PMID: 25735910.
- [xvi]. Cadorin L, Bressan V, Palese A. Instruments evaluating the self-directed learning abilities among nursing students and nurses: a systematic review of psychometric properties. *BMC Med Educ*. 2017 Nov 25;17(1):229. doi: 10.1186/s12909-017-1072-3. PMID: 29178924; PMCID: PMC5702155.
- [xvii]. Chakkaravarthy K, Ibrahim N, Mahmud M, Venkatasalu MR. Predictors for nurses and midwives' readiness towards self-directed learning: An integrated review. *Nurse Educ Today*. 2018 Oct;69:60-66. doi: 10.1016/j.nedt.2018.06.030. Epub 2018 Jul 5. PMID: 30007149.
- [xviii]. Alotaibi KN. The learning environment as a mediating variable between self-directed learning readiness and academic performance of a sample of Saudi nursing and medical emergency students. *Nurse Educ Today*. 2016 Jan;36:249-54. doi: 10.1016/j.nedt.2015.11.003. Epub 2015 Nov 10. Erratum in: *Nurse Educ Today*. 2016 Mar;38():155. PMID: 26586258.
- [xix]. Tio RA, Stegmann ME, Koerts J, van Os TW, Cohen-Schotanus J. Weak self-directed learning skills hamper performance in cumulative assessment. *Med Teach*. 2016;38(4):421-3. doi: 10.3109/0142159X.2015.1132411. Epub 2016 Jan 28. PMID: 26822283.
- [xx]. Slater CE, Cusick A, Louie JCY. Explaining variance in self-directed learning readiness of first year students in health professional programs. *BMC Med Educ*. 2017 Nov 13;17(1):207. doi: 10.1186/s12909-017-1043-8. PMID: 29132327; PMCID: PMC5683311.

Conclusion

In this study, rain classroom teaching method was used in stomatology teaching of nursing undergraduates. The novel teaching method not only enhanced the study interests of students and activated the mood of the class, but also promoted the SDLA and students' satisfaction. The reasons why nursing undergraduates like classroom teaching are as follows: Firstly, students don't need to take notes at class with the help of rain classroom and they can concentrate on learning. Secondly, Preview and review materials pushed before and after class could help students prepare and review pertinently. Thirdly, exercises are sent to each student's mobile phone, so students could answer at the same time. The random roll call function of rain classroom makes students feel lucky to be asked. Finally, the rain classroom breaks the learning limitation of time and space, students could study anywhere using the phone and internet.

Multicenter, large sample and mixed research method are needed to furtherly explore the long-term influence and teaching effect of rain classroom teaching and traditional teaching on students' self-directed learning ability.

Abbreviations

SDL: Self-directed learning; SDLA: Self-directed learning ability

Declarations

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Authors' contributions

YJW was responsible for conception and design of the study. YJW, YQG and LLY performed data extraction and data analysis. YJW wrote the manuscript. JBL and CL contributed to the revision of the manuscript. All authors have reviewed the manuscript and given final approval of the version to be published.

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Availability of data and materials

The underlying datasets are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

All study materials were approved by Committee on Human Experimentation of China Medical University (2018-32). All methods were performed in accordance with the relevant guidelines and regulations. Students provided their written informed consent prior to responding to the survey questions.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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References

1. Mazur E. Education. Farewell, lecture? *Science*. 2009 Jan 2;323(5910):50-1. doi: 10.1126/science.1168927. PMID: 19119207.
2. Naeimi L, Abbaszadeh M, Mirzazadeh A, Sima AR, Nedjat S, Mortaz Hejri S. Validating Self-Reflection and Insight Scale to Measure readiness for Self-Regulated Learning. *J Educ Health Promot*. 2019 Aug 30;8:150. doi: 10.4103/jehp.jehp_101_19. PMID: 31544115; PMCID: PMC6745879.
3. Premkumar K, Vinod E, Sathishkumar S, Pulimood AB, Umaefulam V, Prasanna Samuel P, John TA. Self-directed learning readiness of Indian medical students: a mixed method study. *BMC Med Educ*. 2018 Jun 8;18(1):134. doi: 10.1186/s12909-018-1244-9. PMID: 29884155; PMCID: PMC5994133.
4. Bi M, Zhao Z, Yang J, Wang Y. Comparison of case-based learning and traditional method in teaching postgraduate students of medical oncology. *Med Teach*. 2019 Oct;41(10):1124-1128. doi: 10.1080/0142159X.2019.1617414. Epub 2019 Jun 19. PMID: 31215320.
5. Hwang LL. Educational Intervention on Undergraduate Cancer Awareness and Self-Directed Learning. *J Cancer Educ*. 2018 Jun;33(3):592-601. doi: 10.1007/s13187-017-1210-y. PMID: 28315145.
6. Ramnanan CJ, Pound LD. Advances in medical education and practice: student perceptions of the flipped classroom. *Adv Med Educ Pract*. 2017 Jan 13;8:63-73. doi: 10.2147/AMEPS109037. PMID: 28144171; PMCID: PMC5245805.
7. Alharbi HA. Readiness for self-directed learning: How bridging and traditional nursing students differs? *Nurse Educ Today*. 2018 Feb;61:231-234. doi: 10.1016/j.nedt.2017.12.002. Epub 2017 Dec 11. PMID: 29248841.
8. Scott K, Morris A, Marais B. Medical student use of digital learning resources. *Clin Teach*. 2018 Feb;15(1):29-33. doi: 10.1111/tct.12630. Epub 2017 Mar 16. PMID: 28300343.
9. Zhang X, Wen D, Liang J, Lei J. How the public uses social media wechat to obtain health information in china: a survey study. *BMC Med Inform Decis Mak*. 2017 Jul 5;17(Suppl 2):66. doi: 10.1186/s12911-017-0470-0. PMID: 28699549; PMCID: PMC5506568.
10. Zeng F, Deng G, Wang Z, Liu L. WeChat: a new clinical teaching tool for problem-based learning. *Int J Med Educ*. 2016 Apr 25;7:119-21. doi: 10.5116/ijme.5708.e5c4. PMID: 27111920; PMCID: PMC4844534.
11. Ma D, Cheng K, Ding P, Li H, Wang P. Self-management of peripherally inserted central catheters after patient discharge via the WeChat smartphone application: A systematic review and meta-analysis. *PLoS One*. 2018 Aug 28;13(8):e0202326. doi: 10.1371/journal.pone.0202326. PMID: 30153253; PMCID: PMC6112638.
12. Wu Q, Huang Y, van Velthoven MH, Wang W, Chang S, Zhang Y. The effectiveness of using a WeChat account to improve exclusive breastfeeding in Huzhu County Qinghai Province, China: protocol for a randomized control trial. *BMC Public Health*. 2019 Dec 2;19(1):1603. doi: 10.1186/s12889-019-7676-2. PMID: 31791295; PMCID: PMC6889429.
13. Zhang F, Yuen LW, Ding L, Newman IM, Shell DF. Pilot Study of a Brief WeChat Intervention in China to Increase Students' Willingness to Assist a Flushing Student to Reduce Alcohol Use. *J Prev Med Public Health*. 2018 Nov;51(6):320-325. doi: 10.3961/jpmph.18.127. Epub 2018 Nov 7. PMID: 30514062; PMCID: PMC6283739.
14. Zhang W, Li ZR, Li Z. WeChat as a Platform for Problem-Based Learning in a Dental Practical Clerkship: Feasibility Study. *J Med Internet Res*. 2019 Mar 19;21(3):e12127. doi: 10.2196/12127. PMID: 30888328; PMCID: PMC6444215.
15. Guraya SY, Al-Qahtani MF, Bilal B, Guraya SS, Almaramhy H. Comparing the extent and pattern of use of social networking sites by medical and non medical university students: a multi-center study. *Psychol Res Behav Manag*. 2019 Jul 29;12:575-584. doi: 10.2147/PRBM.S204389. PMID: 31534376; PMCID: PMC6681135.
16. Liu T, Luo J, He H, Zheng J, Zhao J, Li K. History-taking instruction for baccalaureate nursing students by virtual patient training: A retrospective study. *Nurse Educ Today*. 2018 Dec;71:97-104. doi: 10.1016/j.nedt.2018.09.014. Epub 2018 Sep 25. PMID: 30268075.
17. Domen J, Hornstra L, Weijers D, van der Veen I, Peetsma T. Differentiated need support by teachers: Student-specific provision of autonomy and structure and relations with student motivation. *Br J Educ Psychol*. 2020 May;90(2):403-423. doi: 10.1111/bjep.12302. Epub 2019 Jul 2. PMID: 31267512; PMCID: PMC7318603.
18. Knowles M. Self-directed learning: a guide for learners and teachers. New York: Associated Press. 1975

19. Slater CE, Cusick A. Factors related to self-directed learning readiness of students in health professional programs: A scoping review. *Nurse Educ Today*. 2017 May;52:28-33. doi: 10.1016/j.nedt.2017.02.011. Epub 2017 Feb 14. PMID: 28229917.
20. Cheng SF, Lee-Hsieh J, Turton MA, Lin KC. Validation of self-directed learning instrument and establishment of normative data for nursing students in taiwan: using polytomous item response theory. *J Nurs Res*. 2014 Jun;22(2):90-100. doi: 10.1097/JNR.000000000000027. PMID: 24821416.
21. Cadorin L, Rei A, Dante A, Bulfone T, Viera G, Palese A. Enhancing self-directed learning among Italian nursing students: A pre- and post-intervention study. *Nurse Educ Today*. 2015 Jun;35(6):746-53. doi: 10.1016/j.nedt.2015.02.004. Epub 2015 Feb 18. PMID: 25735910.
22. Cadorin L, Bressan V, Palese A. Instruments evaluating the self-directed learning abilities among nursing students and nurses: a systematic review of psychometric properties. *BMC Med Educ*. 2017 Nov 25;17(1):229. doi: 10.1186/s12909-017-1072-3. PMID: 29178924; PMCID: PMC5702155.
23. Chakkaravarthy K, Ibrahim N, Mahmud M, Venkatasalu MR. Predictors for nurses and midwives' readiness towards self-directed learning: An integrated review. *Nurse Educ Today*. 2018 Oct;69:60-66. doi: 10.1016/j.nedt.2018.06.030. Epub 2018 Jul 5. PMID: 30007149.
24. Alotaibi KN. The learning environment as a mediating variable between self-directed learning readiness and academic performance of a sample of saudi nursing and medical emergency students. *Nurse Educ Today*. 2016 Jan;36:249-54. doi: 10.1016/j.nedt.2015.11.003. Epub 2015 Nov 10. Erratum in: *Nurse Educ Today*. 2016 Mar;38():155. PMID: 26586258.
25. Tio RA, Stegmann ME, Koerts J, van Os TW, Cohen-Schotanus J. Weak self-directed learning skills hamper performance in cumulative assessment. *Med Teach*. 2016;38(4):421-3. doi: 10.3109/0142159X.2015.1132411. Epub 2016 Jan 28. PMID: 26822283.
26. Slater CE, Cusick A, Louie JCY. Explaining variance in self-directed learning readiness of first year students in health professional programs. *BMC Med Educ*. 2017 Nov 13;17(1):207. doi: 10.1186/s12909-017-1043-8. PMID: 29132327; PMCID: PMC5683311.