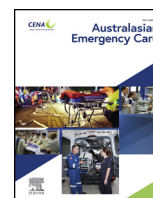




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## Research paper

# Delivering an online course in emergency nursing education during the pandemic: What are the effects on students' learning?



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## ABSTRACT

**Background:** Online learning emerged as an auxiliary approach in 2013 when MOOCs were imported and popularized in Chinese universities, particularly in the duration of pandemic outbreaks worldwide. World health organization (WHO) had recommended online education to keep social distance which still needs further evaluation. This study aimed to examine whether an open online course is superior to conventional education in emergency nursing during the COVID-19 pandemic.

**Methods:** Two groups of conventional education students (CG) and two groups of students participating in an online course that utilized an application (called SuperStar) as the SuperStar Group (SSG) were studied to compare their abilities in the process of new knowledge acquisition. The SSG was divided into a blended group (S1) and an online group (S2). The emergency nursing course was scheduled in 16 independent classes, which contained stochastic tests at least eight times.

**Results:** The CG group showed better performance on the final exam than the SSG group, but there was no statistically significant difference. The CG group obtained better scores on the memory capacity tests while the SSG had better scores on the application capacity tests. The SSG group scored higher on the later tests during the process of education compared to the CG group.

**Conclusions:** Comprehension of an emergency nursing course was stronger in the SSG group than in the CG group. Horizontal comparison of subentry tests discriminated between the groups, with a better trend for the SSG group in application ability. There are potential effects on chronological learning through the use of the online course for emergency nursing education, not only during COVID-19 but also in the post-pandemic era.

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## 1. Introduction

Massive Online Open Courses (MOOCs) were initiated by Ivy League schools in the United States a decade ago. MOOCs bring together world-famous teachers and international scholars for efficient and effective education in an open learning environment [1,2]. The emergence of MOOCs contributes to education by providing a good forum for learning and making full use of available time by breaking through the “wall” of the university campus. This innova-

tive approach makes education available to all participants as long as they can access the Internet. Flourishing MOOCs facilitate access to tremendous online courses worldwide through platforms such as Edx and Udacity. The utilization of MOOCs worldwide has recently strengthened global online courses, which have spread in the new millennium [3]. Based on the popularization of computerized techniques in educational strategies, online learning has turned into one of the important approaches, parallel to the conventional courses, especially during the pandemic in countries such as India and China [4].

Online learning emerged as an auxiliary approach in 2013 when MOOCs were imported and popularized in Chinese universities [5]. According to reports from the Ministry of Education of China, 3000 national-quality curricula were released for open online enrollees, and over 40,000 provincial online courses were established for undergraduate students in 2019. Various platforms, such as the

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**What is known?**

This research addressed the effects of an online course on Emergency Nursing education in the pandemic period. Online learning provided convenience and keep the social distance effectively in a special time. In terms of Emergency Nursing education, online courses supported more to the conceptional understanding compared to the conventional approach, while did lesser in the skill training class. In addition, the online course can approve the accumulative knowledge acquaintance and strengthen the ability of application.

**What does this paper add?**

This study was carried out in the duration of COVID-19(2020/03-2020/07), the period when the Chinese government shut down the majority of cities and repelled all the students out of campus. Nursing students received the special class service by the online courses including the Emergency Nursing course. Finally, the mission accomplished in Emergency Nursing. Online learning facilitated the possibility of remote education in multiple forms. Online learning can also reinforce conceptional comprehension and accumulative understanding when acquaint new knowledge.

“Smart Tree” Platform, “Chinese MOOCs” Platform, and “School Online” was authorized by the government to provide online course services to universities. These platforms have contributed to the maturation of regional and national alliances that foster teacher development centers, which are recognized as powerful and efficient teacher organizations. Over three million students per year benefit from approximately 80 official or civil online educational organizations that provide online course credits [6]. Among these organizations, a platform called “SuperStar” has helped half of the universities in China to offer tremendous online courses.

Medical education, characterized by theoretical abstraction and technical complexity, is extensively multiconnected with online educational strategies. The use of video animation has fostered learning and open discussion, which not only supplemented the shortcomings of class ambiguities but also stimulated students’ interest in innovative education [7]. The Chinese Academy of Sciences (CAS) has called to focus on online medical course delivery to undergraduate students by encouraging professionals and celebrities to develop a series of valuable curricula, including nursing courses. It has been reported that over 100,000 [8] online medical courses have been established in China, among which approximately 2500 nursing courses are available to students [9].

Emergency nursing has developed into a compulsory course in nursing education in China [10]. The course emphasizes clinical skills, basic theoretical knowledge, understanding of applied medical theory, and skills in handling severe disease diagnosis and treatment. Emergency nurses became a major force in the fight against severe diseases as well as in accident rescue and catastrophe response [11]. Traditional emergency nursing courses indeed provide benefits for students in terms of conceptional understanding, but they still need reinforcements, such as online courses, to increase information and perspective, especially during the COVID-19 pandemic.

As of August 20, 2020, based on online course recommendations by the WHO during the spread of COVID-19, remote education has reached 1.5 billion students worldwide during the period of shutdown. Coronavirus had removed 2.3 million students from campuses, leading to massive online courses in the first quarter of 2020 in China. Emergency nurse candidates experienced pure online learning during their preclinical period, the effects of

**Table 1**  
Method of Grouping and Test.

Method	SSG		CG
	S1	S2	
Grouping Strategy	A1511 (n=30) Mixed Blended In China	A1811 (n=30) Exclusive Online In Korea	A1311/A0911 (n=30/30) Conventional
Final test	1	1	1
Stochastic Test	8(6)	9(6)	13(6)/11(6)

S1: class series: A1511 in 1st-semester for blended approach.  
S2: class series: A1811 in 2nd-semester for online approach.  
SSG: Super Star Group (Online course).  
CG: Conventional Group.

which are still unknown. To cope with the ongoing consequences of COVID-19, it is necessary to offer an additional option as an efficient channel for emergency nursing education. This study focused on the assessment of the differences between a conventional course and an online course developed to offer a remote solution during the pandemic.

**2. Materials and methods**

*2.1. Grouping*

Undergraduate nursing students were screened against the inclusion criteria and exclusion criteria. All officially enrolled nursing students in the past 10 years were recruited, and the exclusion criteria encompassed a class size of over 30 to maintain the sample standard of 30. The online education students were randomly divided into two groups. Specifically, 30 nursing students (class series: A1511, duration of intervention: March 2017 to July 2017) who experienced a mixture of online and offline courses were identified as S1 (blended) subgroup, while 30 nursing students (class series: A1811, duration of intervention: March 2020 to July 2020) who experienced exclusively online courses were identified as S2 subgroup. Both the S1 and S2 subgroups received the entire online emergency nursing course from a platform called SuperStar, an official online curriculum platform, and they were defined as the SuperStar group (SSG). The control group was composed of 30 students from two traditional nursing education classes (class series: A1311 and A0911, duration of intervention: March 2015 to July 2015; March 2011 to July 2011, respectively), and they were identified as the “conventional group” (CG) (Table 1).

*2.2. Design*

**Preparation:** All the students in the SSG group downloaded the “SuperStar Universal Learning” system beforehand. The course content and teaching schedules for the entire semester were listed in advance. The CG students were educated in line with regular instructions, which had been implemented for years.

**Curriculum design:** All students were required to complete the whole schedule of emergency nursing (16 classes). At least one examination was needed after every two classes delivered, followed by one final examination at the end of the semester.

**Educative manipulation:** The S1 students experienced the mixed strategies of the online course and participated in four face-to-face class meetings with an instructor (cardiopulmonary resuscitation, trauma treatment, intensive care manipulation, and common disease treatment). There was no time limit. Attendance, interactive scores, and manipulation scores were recorded and collected for analysis (Table 1).

The S2 students experienced an exclusive online course comprising 14 live Internet webinars launched by the instructors from

the Republic of Korea, without any face-to-face class meetings, for which preparations were done online in advance. In addition, practice videos of four offline operations (cardiopulmonary resuscitation, trauma treatment, intensive care manipulation, and airway obstruction removal) were appended. Operation evaluation, attendance, and interactive scores were recorded by the teacher.

The CG students attended traditional classes as usual in the past 10 years. All data, including exams and assessments, were retrieved from the former records for analysis.

**Assessment:** All tests and assessments were conducted in the intervals of every two class deliveries, which resulted in at least eight outcomes in total, plus the final examination. Only the tests were considered for the assessment of class performance, and the attendance marks and practice scores were ruled out. Hence, six sets of outcomes out of all tests were stochastically selected for the comparison, in addition to the final examination.

2.3. Statistical analysis

All data were analyzed using mixed-model ANOVA, repeated-measures ANOVA, or *t*-tests, as appropriate. Significant main effects or interactions were followed by Fisher’s protected least-significant difference (PLSD) *post hoc* analyses. Assessment data, as factors tested using two-way ANOVA, were followed by Fisher’s PLSD *post hoc* test. An unpaired *t*-test was used to determine the mean and discrete distribution of the data. Statistical differences were considered significant when *p* was below 0.05. The data were handled by the StatView system (StatView 5.0, SAS Institute Inc., USA). The schematics were created by Graphpad Prism 7-92150 system (GraphPad Software, Inc., La Jolla, CA).

3. Results

3.1. Comparison of SSG and CG student performance after course completion

First, we compared the final examination performance of students between the conventional approach (CG) and the blended approach (S1). There was no statistically significant difference between the groups although the CG score was slightly higher (*p*=0.073) (Fig. 1). This result was validated in the next comparison between the CG students and pure online students (S2). Our data were consistent with the theory that online education does not decline the understanding or knowledge of a subject [12].

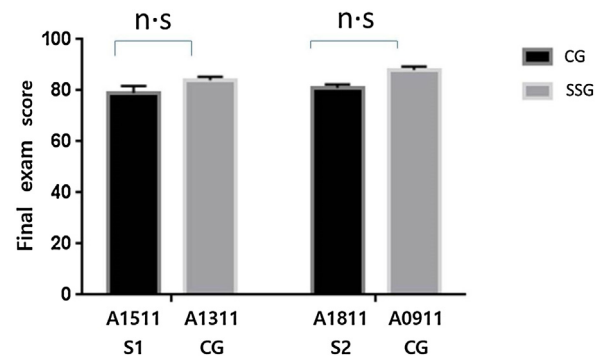


Fig. 1. Comparison of final examination between SSG and CG. The final exam score is compared between CG and SSG. The left column is the comparison between A1511 (*n*=30) and A1311 (*n*=30); the right column is the comparison between A1811 (*n*=30) and A0911 (*n*=30) as shown in Table 1. There is no significant difference in the final test in conventional, blended, and online learning strategies. n-s, no significant difference; CG, Conventional Group; SSG, SuperStar Group (Online course). S1, class series: A1511 in 1st-semester for blended approach; S2, class series: A1811 in 2nd-semester for online approach

3.2. Advantages demonstrated between the groups at subentry assessment

In China, traditional testing includes several types of subentry assessments: concept explanation (memorization of theory and concepts), filling in the blank (completing a sentence with the correct word or words), selection (choosing the correct answer among four to five possible answers), short answer (answer requiring a correct statement, such as a sentence), and analysis (one or more cases that require a detailed resolution) [13]. Recent studies [14,15] divided the measurement of students’ knowledge acquisition into two components: Memory Capacity (MC, assessment including concept explanation, filling in the blank, and A1 one-choice selections) and Application Capacity (AC, assessment including A2/A3/A4 multiple-choice selections, short answer questions, and analysis) (Fig. 2A). We completed a horizontal comparison of subentry assessments between the groups to identify the differences between the two groups. We showed that the students in the CG were better at concept explanation, while the students in the SSG group were better at analysis evaluation. There was no statistically significant difference in the filling-in-the-blank evaluation between the groups despite a slightly higher score in the CG group. The other sub-items, including selection and short-answer question evaluations, were indistinguishable (Fig. 2B). The students

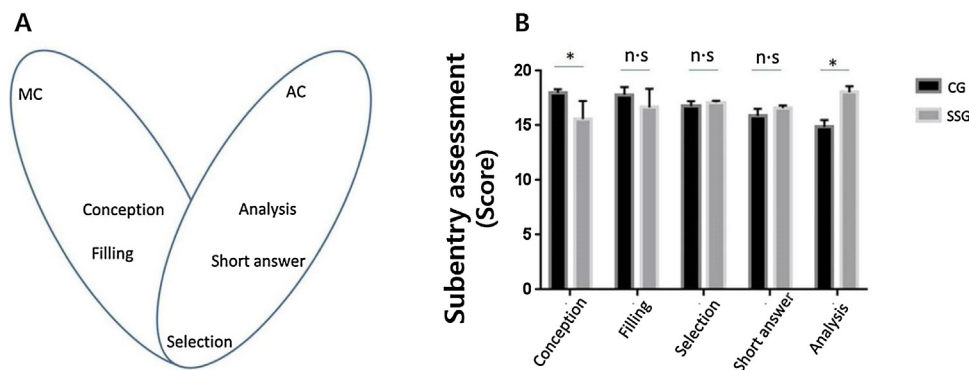
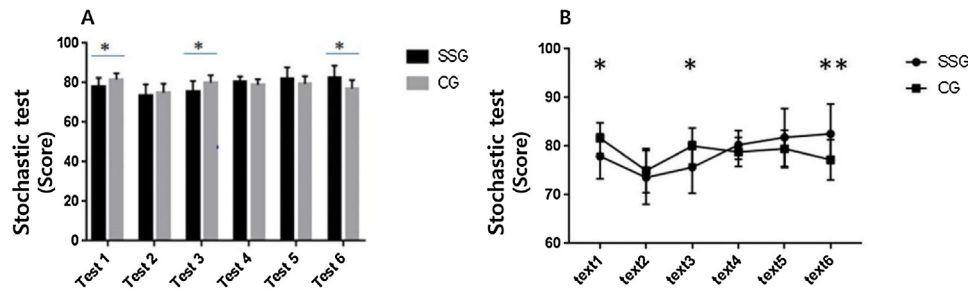


Fig. 2. Subentry evaluation disparity components. A. Schema of integrity acquaintance. Knowledge integrity acquaintance is divided into two parts with a portion of overlaps: Memory Capacity (MC assessment including concept explanation, filling in the blank and A1 one choice selections) and Application Capacity (AC assessment including A2/A3/A4 multiple-choice selections, quick answer questions, and analysis & solutions). B. Performance of subentry evaluation components. Different subentry test comparison between SSG and CG. The evaluation of the ability to memorize concepts in SSG is lower scored while the analytic ability is higher scored compared to CG. Data presented with mean ± SEM, \* *p* < 0.05, by two-way ANOVA (*post hoc* with Fisher’s PLSD). n-s, no significant difference; CG, Conventional Group; SSG, SuperStar Group (Online course); MC, Memory Capacity; AC, Application Capacity.



**Fig. 3.** Schematic diagram of the trend curve for acquaintance with new knowledge. A. Chronological stochastic tests (n = 6 selected from the whole tests) between SSG and CG. B. Learning trend for knowledge acquaintance based on chronological test. Data presented with mean ± SEM, \* p < 0.05, by two-way ANOVA (post hoc with Fisher's PLSD). CG, Conventional Group; SSG, SuperStar Group (Online course).

**Table 2**  
Chronological stochastic test results: mean ± SEM.

	SSG (A1811)	CG (A1311)	p-Value (two-way ANOVA)
1	77.93 ± 4.63	81.63 ± 3.19	0.001
2	73.60 ± 5.52	75.00 ± 4.52	0.287
3	75.67 ± 5.33	80.07 ± 3.69	0.005
4	80.27 ± 2.95	78.83 ± 2.97	0.066
5	81.83 ± 5.94	79.47 ± 3.87	0.072
6	82.57 ± 6.07	77.23 ± 4.16	<0.001

SSG: Super Star Group (Online course).  
CG: Conventional Group.

in the CG group did well in the MC, while the students in the SSG group did well in the AC.

### 3.3. Differences in knowledge progress among the groups

To evaluate the learning trends of students in the two groups, we stochastically compared six exams randomly selected from the chronologically ordered tests (Table 1). During the early stage of the course, the performance of the CG students (81.63 ± 3.19) was better compared with the SSG students (77.23 ± 4.16; F<sub>2, 30</sub> = 4.65, p = 0.001); however, the performance reversed in the later phase (CG students: 77.23 ± 4.16; SSG students: 82.57 ± 6.07; F<sub>2, 30</sub> = 8.764, p < 0.001) (Table 2) (Fig. 3A). In the representative learning trend, the curve of the SSG group was below the CG group in the beginning, but it rose at the end of the semester (Fig. 3B).

## 4. Discussion

As mentioned above, it is not easy to draw a conclusion that online education indeed facilitates understanding of new knowledge in an emergency nursing course. The cumulative learning assessment in the final examination indicated that the outcome of the emergency nursing course was similar between the CG and SSG groups. This is in agreement with the knowledge-acquisition progress theory pertaining to long-term studies, suggesting that new knowledge conception can be equally accepted once it is completed, irrespective of the manner of learning. In emergency nursing education, skill-training sessions are more crucial than empirical recapitulation in class because proficient clinical skills are required in lifecare or crisis mitigation [16]. In this regard, a face-to-face course might be more helpful for adopting new skills because of body language, face impressions, and interactions. However, an online remote course can strengthen class information by providing an additional demonstration of the concepts in a vivid and direct manner. Perhaps, a blended course that combines theory presentation and an application-oriented course is a better option, if only the skill training is considered.

Comprehension of knowledge should be based on both memory and application capacities. Our data suggested that the SSG

students had better performance in flexible knowledge applications compared with CG students. This phenomenon is consistent with a previous study [17] that showed that online courses encouraged multiple positive forms of education, including active learning, intuitive animation, video teaching, and open discussion, all of which contribute to improved capacity for the comprehensive application of knowledge compared with the conventional approach. In the recent real-world battle against the flood disaster in Jiangxi province in July 2020, the SSG students received better appreciation in their internship for offering appropriate treatment to the wounded.

Emerging evidence suggests a gradient principle whereby students acquire new knowledge from the beginning to the end, which is identified as a learning trend [18]. Assessments made earlier-on are unreliable due to unfamiliarity with course materials [19], while the comprehension improves as connections among knowledge points are enriched and interact over time. Our assessments based on chronologically ordered tests revealed that online education led to higher scores in the later phases of learning. However, this does not suggest that online learning is better than the traditional method. Skill training is time-consuming and requires practice sessions in person. The online approach showed superiority only in whole-course comprehension and the ability to respond to changes.

The integration of digital techniques into modern education is important for the evolution of medical education and is a desired trend for modern medical education as well [20]. The demand for online courses is particularly urgent because emergency nursing requires a more thorough understanding of disease mechanisms, which is as important as proficient knowledge and clinical skills [21]. Other investigations by our research team suggested that the improvements of both the conventional approach and the online method in emergency nursing education are significant. For example, the SSG students' performance in the understanding and application of cardiopulmonary resuscitation (data not shown) was worse than that of CG students. In contrast, the SSG students surpassed CG students in Multiple Organs Dysfunctional Syndrome (MODS), which may be attributed to vivid instructions from the cartoon video. Similar results were found with respect to the topics such as poisoning, intensive care, and trauma treatment.

Of all the tactics the WHO considered to handle the outbreak of COVID-19, the open online course turned out to be an efficient, trustworthy strategy to achieve remote education under the lockdown of cities or countries [22]. On top of its easy access to shared materials, online remote education resolves the problem of keeping social distance with synchronous education during the pandemic. Our research was carried out during the COVID-19 period, which facilitated the need for the course, indicating that the online learning of emergency nursing has become one of the main methods of class delivery; however, skill training in person is still needed. In the case of emergency nursing, online remote education served to provide the theoretical background in the circumstances of inten-

sive coronavirus spread, leaving the training part for the time when the COVID-19 is mitigated.

Nursing skills play a crucial role in the clinical career of a nurse, which is one of the reasons why we selected this course to evaluate the effects of MOOCs in nursing education. In this study, the popularization and application of an online open course in emergency nursing education allowed not only a final examination but also a comprehensive assessment. The present research confirmed that open online courses, as a part of education reform, are efficient and effective tools for emergency nursing theory instruction. However, we cannot estimate the potential differences in the ability valuation in the future clinical career life between the students in the SSG and CG groups. Nonetheless, these capacities are very important in transient emergency response when students face ever-changing critical illnesses during their lifecare careers. Further surveys outside of the campus, such as assessments before or after the internship, are required to evaluate the lasting effects of online learning reform on emergency nursing education.

## 5. Conclusion

This study found that an online approach to emergency nursing education was more effective than conventional approaches in terms of comprehensive analysis and understanding of the subject—especially the application of knowledge, which provides benefits to students in their preclinical internships—but not in skill-training aspects. In summary, an online course in emergency nursing has positive effects on chronological learning, not only during COVID-19 but also in the post-pandemic era.

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## Conflicts of interest

The authors have no conflicts of interest to declare.

## IRB number

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## Authors' contributions

All authors meet the criteria for authorship as established by the International Committee of Medical Journal Editors, believe the paper represents honest work, and are able to verify the validity of the results reported. All authors read and approved the final manuscript.

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