On the Curricular Innovation Practice of the Recurve Bow Based on Blended Teaching

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Abstract. In order to verify the practical effect of the blended teaching in the course of recurve bow, this paper designed a new model for the course and compared it with the traditional model based on the constructivist theory and the "nine-stage" teaching method with the help of the "superstar platform". The number of hit rings (SAH), teachers' technical evaluation (TTR), the number of execution errors (OET), and the length of equipment disassembly and assembly (DAT) of the experimental group and the control group for independent sample t-test were collected; then the platform data (LPD) and subjective opinions (SSV) were summarized and analyzed in the experimental group. The results showed that the SAH, TTR, OET and other indicators of the experimental group were better than those of the control group, and the feedback of LPD and SSV was good, but the DAT was worse than that of the control group. The blended teaching improved the quality of the recurve bow learning and helped to improve the continuity of the learning state; when comes to the process-based and form-fixed content, its effect needs to be further discussed.

Keywords: blended teaching · recurve bow · teaching pattern · online teaching resources

1 Introduction

The concept of blended teaching has sprouted since the end of the last century, and has mainly experienced three major stages of development: technology application (from the late 90's to 2006), technology integration (2007–2013) and deep integration (2013-present). The emergence of the covid-19 also causes an urgent innovation in network teaching. Based on the relevant overviews, there are many researches on this issue, at the teaching and personnel training mode aspects, the blended teaching is superior than the traditional teaching [1, 2].

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On the influence of the concept of "Internet+education", the teaching structure and the method of physical education in universities and colleges are impact dramatically. The blended teaching urges the physical education turns from close to open, from single to multiple, and from traditional mono infusing to interactions [3]. Nowadays, blended teaching's application in physical education mainly reflects in some macro aspects, like teacher development [4], learning motivation [5], curriculum pattern [6], while the practical effects on specific courses are rarely carried out; and the research methods focus on the literature review, the observation, the concept analysis and so on, seldom on the empirical. Besides, the nowadays blended mostly adopted the "double-line" strategy, not the "Bilinear Fusion", which is necessary to enhance the bilateral interaction and create a synchronic and multi-link teaching process [7]. This paper considered that blended teaching researches must combine with the specific sport event, especially the newly emerging physical education subject, with this combination, the teaching methods could be further implemented in the practical.

This paper took the course of recurve bow (archery) as a breakthrough to carried out the research and innovation of blended teaching. In recent years, the recurve bow movement has gradually emerged in China's colleges and universities. It is novel and becomes very popular among college students. Through nearly two years of this subject teaching experience, it is found that for ordinary students without any experiences, the influence of neural proprioception and the cognitive level of the theoretical knowledge of bows and archeries on the performance may be higher than that of technical movements and muscle strength, which is significantly different from the teaching rules of other sports. So, it is considered that taking the advantages of the network platform for teaching would be suitable; Besides, there is no blended teaching research on the course of recurve bow at home and abroad. This paper based on the relevant teaching theory, designed a new teaching mode and carried out control experiment. And also provided relevant basis for the development and popularization of the recurve bow course in colleges and universities.

2 The Theoretical Basis of the Blended Teaching Design of the Recurve Bow

2.1 The "Four Attributes" and "Three Elements"

The constructivist learning theory was first proposed by the Swiss psychologist Piaget, who believed that students were the active constructors of knowledge, it emphasized student-centered, and regarded "situation", "cooperation", "conversation" and "meaning construction" as the four attributes of construction [8]. The basic concept of blended teaching was consistent with it. When designing teaching processes, teachers need to put students in the main position and carry out reverse design according to the curriculum objectives, which should include three elements: first, enable the students to actively participate in inquiry activities; second, give full play to students' autonomous learning ability and initiative; third, adopt diversified evaluation to develop students' metacognition and deep learning ability [9].

2.2 Take the "Nine-Stage" Teaching Method as a Mainline

The "nine-stage" teaching method, proposed by American educational psychologist Gagne, was a teaching strategy based on learners' psychological process. Gagne divided teaching into nine steps: drawing attention, informing learning objectives, arousing memories, presenting stimulating materials, providing learning guidance, eliciting behavioral performance, providing feedback, measuring behavioral performance, and promoting knowledge retention and transfer [10]. This teaching method clarified the main role and occurrence order of teacher's behavior in the teaching process, and at the same time designed relevant student behaviors before and after teacher's behavior, so as to realized timely and effective information transmission and feedback communication between teachers and students [11]. This research is just referring to the nine-stage teaching method to design the mainline of the course.

2.3 Closely Connect Between the Classes

Some scholars pointed out in 2019 that blended learning can be designed into four series stages, namely: before face-to-face learning (online learning) → during face-to-face learning (offline learning) → after face-to-face learning (online learning) → before the next face-to-face learning (online learning) [12]. Some scholars also proposed that around the three stages of pre-class, in-class and post-class, blended teaching should provide appropriate resources and activities in the appropriate learning environment through appropriate media technology at the appropriate time, so as to promote students to form appropriate abilities and achieve the target effect [13]. In addition, in blended teaching, the mixed mode and degree of comprehensive content are the most difficult points to grasp. Teachers can consider changing the time and space of the course into all-around and all-weather mode, so that students can learn at anytime and anywhere, find and solve problems in the learning process, and give timely feedback with teachers [14].

According to the actual situation of physical education teaching in Chinese universities, the teaching design needs to closely integrate online and offline learning with pre-class, in-class and post-class, and connect them on the timeline through appropriate teaching activities.

2.4 Adjust the Rating Method

Compared with the traditional mode, blended teaching, under the influence of constructivist reverse thinking, focused on what students can do after learning. Therefore, the curriculum increased the proportion of teamwork and autonomous learning activities, and paid attention to students' self-evaluation and peer evaluation [15]. Blended teaching can also let the students be conscious about the learning progress, promote students to learn the methods of self-evaluation and reflection, and use this as the basis for self-regulation [16].

3 The Specific Practice of Courses Based on the Superstar Learning Platform

3.1 The Differences Between the Traditional Course and the Blended Teaching Course of Recurve Bow

Nowadays, most of the colleges and universities in China that offer the recurve bow course are still based on the traditional teaching mode, as shown in Fig. 1, that is, the teacher is the main subject and the student is the object. In the offline course, the teaching task is completed by relying on a large number of explanations, demonstrations and exercises and lack of effective supervision on learning during non-class hours.

Compared with traditional courses, the blended teaching course of recurve bow can use online resources to carry out more teaching activities, integrate the whole teaching process into the platform management, and connect each class together, shown as Fig. 2.

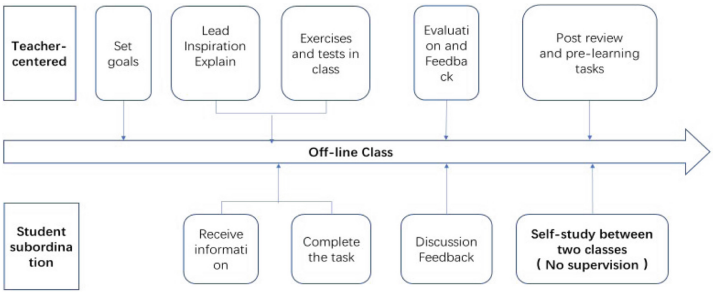


Fig. 1. Traditional teaching mode [owner-draw]

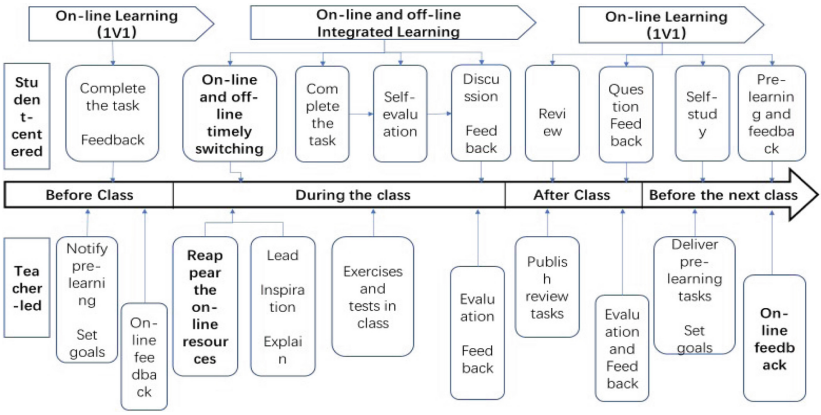


Fig. 2. The blended teaching mode [owner-draw]

3.2 The Specific Arrangement of Blended Teaching Classes

1) The Pre-class Online Sector
Firstly, Release the preview tasks and learning objectives on the platform, notify students to complete online preview resources before class, secondly, feedback individual related questions and opinions; the teacher responds and uses the feedback as a reference for subsequent teaching.

2) The Blended of the Online and Offline Sector
In offline teaching sector, the teacher first reproduces the preview content before the class in combination with the real object on the spot, then explains the main content of the class in the way of guidance and inspiration, and switches the online or offline mode in due time according to the needs, then the teacher assigns in-class learning tasks, and gives students help as appropriate. In the process of learning, students can open online materials at any time for reference, and complete learning tasks through individual or group cooperation, combined with the guidance of teachers. Teacher should also organize students' discussion and self-evaluation according to the teaching arrangement, and give students teaching evaluation and feedback in time.

For different teaching contents, the online and offline integration forms will be different. For example, in the technical part, teachers use their own demonstration and online media materials (pictures, texts, videos, etc.) to explain synchronously, combine pre-class preview with after-class study, stimulate students with multi-sensory signals at the same time, and help them build a deeper movement representation; students can use online materials as a reference for repeated learning to deepen their understanding, discussion between classes, self-evaluation, etc. In the teaching of competition rules, online materials are used as the referee's manual and supervision manual, students learn rules in the role of referee and supervisor. To sum up, teachers should integrate offline classroom and online platform as much as possible.

3) After-Class Plus Before-the-Next-Class Online
After class, the teacher arranges multiple review tasks such as exercises, case analysis, discussion on the online platform, receives students' feedback information, and makes timely evaluation and feedback. Before the next offline class, the teacher informs students to preview online materials, set learning objectives and pre-class tasks, and complete online interaction. When designing the syllabus, teachers should ensure that the two adjacent classes are connected in content in advance.

4 Material and Method

4.1 Purpose of the Experiment

Through comparison between the experimental group of blended teaching mode and the control group of traditional teaching mode, collect the relevant data, and study the difference of teaching effect of recurve bow under the two modes.

4.2 Experimental Subjects

Both the experimental group and the control group are 12 people, including 6 male students and 6 female students, all of whom are non-sports majors. The class arrangement is completed through the school's educational administration system. After confirmation by the teacher, none of the selected students had any archery experience.

4.3 Experimental Time and Site

202209–202211, standard archery field for colleges and universities.

4.4 The Arrangement of the Experiment

According to the physical education curriculum system of the university, the optional course of recurve bow was held once a week, with 2 class hours, i.e. 90 min, and a 5-min break between classes for 8 weeks, totaling 16 class hours. The experimental group gave offline lessons at 15:15–16:50 on Wednesday afternoon, while the control group gave offline lessons at 15:15–16:50 on Thursday afternoon.

In order to ensure the stability of the experiment as much as possible, the two groups were completely exactly the same in terms of teaching content, teacher, teaching time, gender ratio of students and the prerequisites. Male students used 18 lb' bow, and female students used 16 lb' bow. At the same time, the teacher tried to control the amount of practice of the two groups of students at the offline class to be the same or similar (such as the number of target groups, the number of drills, etc.).

During the experiment, the teacher collected the relevant data of the two groups, such as the number of hit rings of arrows, the score of technical movements, the disassembly and assembly time of the equipment, and the number of execution errors, and compared and discussed the data between the groups.

4.5 The Main Rating Item and Method

1) Score of Arrows Hit (SAH)
Hit rate is one of the indicators that directly reflect the sports level of shooting events. At the end of the course, the teacher arranged a target assessment for the two groups of students. During the assessment, one student occupied one arrow path and one arrow target, and the target was 60-type full ring target; each student shot 10 arrows, with a total time limit of 300 s. If there were overtime arrows, it was counted as 0; the distance from the starting point to the bull's eye was set as 10 m; each round will be conducted by two people at the same time; the other basic rules were implemented with reference to the Olympic recurve bow competition; The teacher was responsible for judging the ring and scoring manually on site.

2) Teacher's Technical Rating (TTR)
While measuring the score of arrows hit (SAH), the teacher gave the corresponding technical score (TTR) according to the students' technical actions. The scoring was based on

Table 1. Standard of TTS [owner-draw]

Action quality for 5 movements sector	Score
No error	15
One error	12
Two errors	9
Three errors	6
Four errors	3
Five errors	0

the reference to the "Chinese Sports Coaches On-the-Job Training Textbook: Archery", combined with the relevant research[17], and the technical actions were divided into five links: standing, archery, leaning, aiming and shooting. Each link accounted for 3 points, with a total score of 15 points. Taking into account the physical condition of non-sports major students, this paper reduced the difficulty of the examination. If students had no obvious mistakes in the five links and their movements were smooth, they were rated as full marks. Shown as Table 1.

3) The Course When Arrows Starting to Present Relatively Concentrated (CAC)
This factor means during the whole course, the time that arrows firstly concentrated at certain point. For example, when the falling point of the arrows appears to be dense for the first time in the second half of the fourth week, it can be recorded as the eighth week. In combination with the data in previous years, this study sets the radius range of the denseness of the falling points to 25 cm, and the shooting distance 10 m. Each student was allowed to shoot 6 arrows per round. If more than 4 falling points meet the radius requirements, it was considered as the denseness trend, and the teacher recorded this data.

4) Disassembly and Assembly Time (DAT)
According to the teaching calendar, after learning knowledge about the equipment, the teacher will organize students to test the disassemble time at the offline class on the second week. During each round of test, the teacher organizes two students, the students start to assemble the exercise bow and then disassemble it until it restored to its original state, then the teacher uses a stopwatch to record the time. During the test, in order to avoid equipment damage or potential safety hazards caused by wrong behavior, the teacher can correct students' mistakes at any time, but after each correction, 10 s should be added to the final time until the disassembly and assembly is completed. Each student will be tested twice and get the better one scored. The data is in seconds, rounded to the nearest whole number.

5) Officiating Error Times (OET)
After learning the competition rules, the teacher organized students to have a simulation race in two adjacent classes. The students were randomly divided into four groups

by the teacher, including two athlete groups, one referee group and one supervision group. Each group took turns to conduct role drills. Among them, the athlete team was only responsible for simulating the competition process, while the referee team and the supervision team recorded the number of mistakes by the teacher in the process of judging. Finally, the teacher accumulated the number of mistakes and compared them between the experimental group and the control group.

6) Learning Platform Data (LPD)
The online learning in the experimental group is completed through the "Superstar Learning platform". The platform provides teachers with learning data, including information completion, homework, online interaction, online attendance, etc., and provides reference for this teaching research. All the data collected above is rounded off.

7) Students' Subjective Views (SSV)
This survey is mainly to investigate the subjective evaluation of the experimental group students on the curriculum and the new teaching methods. Teachers collected feedback through anonymous simple questionnaires, but the questionnaire design is not scored, which is only used for comparison between groups. A total of 12 questionnaires were distributed and 12 were retrieved, with the efficiency and recovery rate of 100%.

5 The Result and Discussion

5.1 The Objective Learning Effect

1) The Comparison Between Different Groups of SAH, TTR, CAC, DAT.
In this paper, SPSSAU is used for statistical analysis of four types of data: SAH, TTR, CAC and DAT, the significance level is 0.05.

Since the number of the sample data is less than 50, the normality of the data is needed to be tested. As shown in Table 2, though the TTR appears significance($p < 0.05$), the absolute value of kurtosis is less than 10 and the absolute value of skewness is less than 3, thus the normality is been demonstrated [18]. Other data have obvious normal characteristics ($p > 0.05$). Therefore, the four types of data are subject to normal distribution.

After confirming the normal distribution, the four types of data in the experimental group and the control group were tested with independent samples. As shown in Table 3, the samples from different groups showed significant differences ($p < 0.05$) for SAH, TTR, CAC and DAT, which means that the samples from different groups have differences for the four indicators. The SAH, TTR and CAC of the experimental group were significantly better than those of the control group, while the DAT of the control group was better than that of the experimental group.

According to SAH and TTR, the students in the experimental group have higher hit rate and more standardized technical actions. Compared with the traditional mode, the blended teaching had more interaction and feedback links in teaching process. Teachers and students can break through the time and space constraints and keep in touch at any time; with the help of the online platform, the digital monitoring of teaching was

Table 2. The analysis results of the normality [owner-draw]

name	Sample capacity	average	standard deviation	skewness	kurtosis	Shapiro-Wilk test	
						W	*p*
SAH	24	41.250	11.015	-0.493	0.460	0.978	0.856
TTR	24	12.250	2.489	-0.164	-1.529	0.795	0.000**
CAC	24	9.875	2.542	0.291	-0.880	0.948	0.251
DAT	24	89.875	16.959	0.719	-0.154	0.941	0.171

* $p < 0.05$ ** $p < 0.01$

Table 3. Analysis of the t-test result (between groups) [owner-draw]

group(average ± standard deviation)	SAH	TTR	CAC	DAT
Experimental group ($n = 12$)	46.00 ± 8.98	13.25 ± 2.38	8.75 ± 2.26	96.83 ± 17.18
Control group($n = 12$)	36.50 ± 11.12	11.25 ± 2.26	11.00 ± 2.37	82.92 ± 14.16
T	2.302	2.111	-2.377	2.165
P	0.031*	0.046*	0.027*	0.041*

* $p < 0.05$ ** $p < 0.01$

realized, and it can be managed timely and effectively both in class and outside class. They both greatly improved the flexibility, effectiveness and continuity of teaching. The students in the experimental group can maintain the state of learning in the curriculum, solve problems in time, which indirectly improved their initiative and grasp skills more solidly.

The CAC results showed that the students in the experimental group can have a tendency of falling arrows in the earlier class hours, in the recurve bow movement, the falling and dense arrows represent stable posture, which means that the body movements of each arrow are relatively close to each other when archers shoot, and can control their limbs to achieve consistency to some extent, establish effective proprioception [19]. The difference of CAC indicated that the experimental group established body perception before the control group, and the consistency of movement appeared earlier, which can be regarded as learning faster. When the teaching content were the same, blended teaching has higher learning frequency and more signal stimulation than traditional teaching in the same time through preview, review, online and offline synchronization and switching. This "extra learning time", combined with the platform-based teaching media, promoted students to establish the movement representation earlier, enhanced the perception and control of their own actions, and ultimately improved efficiency [20]. This may be the main reason for the difference.

Surprisingly, although the experimental group had richer learning resources and stronger initiative, the control group performs better on DAT. Combined with classroom

observation, it was found that the students in the experimental group were not only slower than those in the control group in the movement, but also needed teachers to correct more frequently, and often paused and hesitated. The disassembly and assembly steps of the recurve bow are strict and of fixed, so there may not be much autonomy for students, so their proficiency may be limited by the sense of order. At the same time, in blended teaching, there were four transmission channels: teacher to student, platform to student, student to student and students themselves. The same content can be cut in different ways in each channel. This paper speculated that these differences might interfere with each other when comes to the 'fixed stereotypes. In traditional teaching, the "handle" demonstration explanation was directly acted by the teacher on the students, and the transmission path was single, it might be more suitable for this situation. In addition, education in most parts of China tended to be standardized, and many students liked to seek standard answers. They might prefer to learn passively when faced with procedural problems. This problem is needed further demonstration.

2) Inter-group Comparison of OET

According to statistics, the experimental group made 12 mistakes in the process of simulated execution, while the control group made 23. As shown in Fig. 3, the difference between the two is very obvious. The learning of competition rules focused on application, so the simulation exercise was a test of the mastery of theoretical knowledge. In the process of learning the competition rules, in addition to listening to the teacher's explanation, the experimental group completed multiple rounds of self-study through online pictures, texts and videos published online before, during and after the class, and completed extracurricular exercises. The frequency and form of learning stimulation were much more than those of the control group, so the degree of mastery of theory was higher. Under multi-dimensional, multi-frequency and multi-sensory mode stimulation, the differences between OET and SAH, TTR and CAC were basically consistent with previous studies.

3) LPD Feedback

The online learning of the experimental group was completed through "Superstar Learning" platform. According to LPD, the average score of 12 students was 84 points, including 8 in 80–100 and 4 in 60–79, with an excellent rate of more than 60%; A total of 30

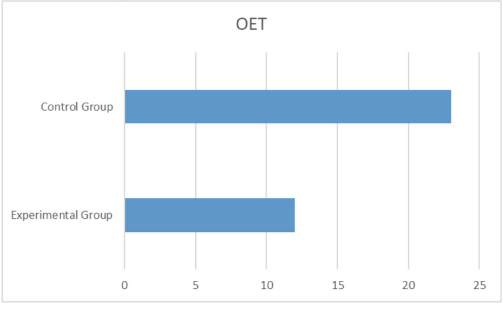
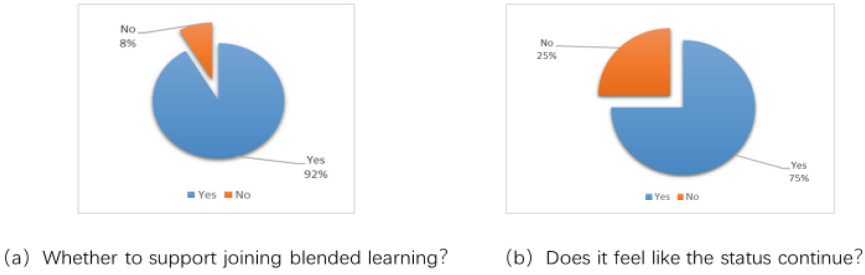


Fig. 3. Comparison [owner-draw]

task points had been set up in the course, and students had completed 29 on average; the average score of online homework was 92, and the average completion rate was 98%, with 12 people in 80–100 segments; the teacher released five discussion topics, and teachers and students had 97 discussions; online check-in rate was 100%. The cumulative viewing volume of the course homepage reached 15663, and the highest frequency of online activities reached 1921. Only from the feedback of LPD, 12 students showed quite high learning enthusiasm, good interaction between teachers and students, and outstanding theoretical learning effect, which reflected students' high learning interest and initiative.

5.2 Subjective Investigation

For the blended teaching, the SSV of the experimental group is shown in Fig. 4 and Fig. 5. With regard to the single topic: whether to support blended learning or not, 92% of the students held a "supportive" attitude, while only 8% of the students objected, the blended teaching was approved by most of the students; as for "whether there is a sense of continuity of learning state" between the two classes, 75% of the students said they could feel it, which showed that the series design realized the overall connection.. In addition, in the multiple-choice of "What do you think blended teaching has improved compared with other offline physical education classes", 11 students said they had improved their



(a) Whether to support joining blended learning? (b) Does it feel like the status continue?

Fig. 4. Single choice [owner-draw]

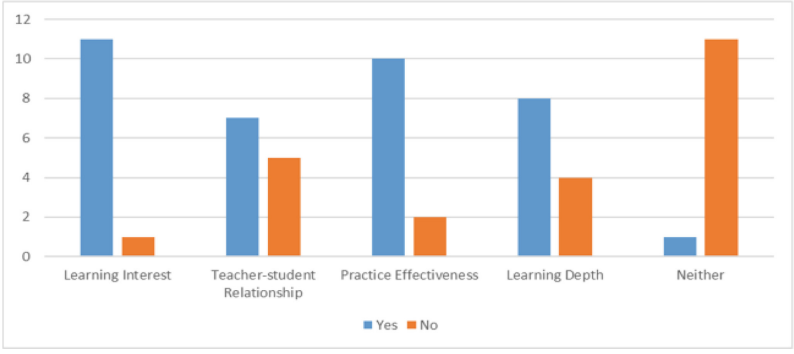


Fig. 5. Multiple choices [owner-draw]

learning interests, 7 students reported they had improved the teacher-student relationship, 10 students said they had improved the practice effect, and 8 people said they had enhanced their depth of learning, only 1 student reported there were no differences. Blended teaching has been approved by the majority of students, with high subjective satisfaction.

6 Conclusion

Relying on multi-dimensional, multi-frequency and multi-sensory signal stimulation, the blended teaching of recurve bow increased the working load; stimulated learning interest, initiative and teacher-student interaction; increased the quality of learning, strengthened the connection between courses, and helped students continue their learning state, so to improved learning efficiency.

This paper focused on teaching design and its results, and needed to be further explored in resource allocation and teaching evaluation aspects, and the blended course of recurve bow needed to be further improved. In addition, when it comes to the content that emphasizes the process and the relatively fixed form, whether the blended teaching has more advantages than the traditional method needs to be further demonstrated.

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