A Study on "Double-subject" Teaching Mode of Sport Statistics Course

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Abstract—Sport Statistics is an important applied subject in physical education field. Traditional teaching cannot meet its teaching demand. As a result, teachers are difficult in teaching and students are difficult in learning. Thus, it is very necessary to combine Sport Statistics with network teaching. In this study, the students of sports specialty were chosen as the objects of study, and "double-subject" teaching mode was used to teach Sport Statistics. Sport Statistics was combined with network course, and a new Web-based online courseware making platform system was applied. Besides, a network course quality evaluation model was constructed, and the evaluation was conducted from 7 aspects: teaching content U1, teaching design U2, course resource U3, page design U4, technical force U5, teacher as the subject U6 and user experience U7. It is found that "double-subject" teaching mode can significantly improve the teaching effect of Sport Statistics, motivate students' learning interest, promote students' oral expression ability, generalization and summarization ability, and self-learning ability, and enhance students' ability to analyze and solve problems.

Keywords—Double-subject; Sport Statistics; course quality; evaluation

1 Introduction

Sport Statistics is an important applied subject in physical education field. The course adopts statistical method and principle for statistics, description, deduction and analysis of stochastic phenomena in physical education, scientific research, training and management, thus revealing the change rules of sports development. It cannot be replaced by other subjects [1]. Because of network-related particularity of Sport Statistics, traditional teaching cannot meet its teaching demand. Thus, teacher's teaching difficulty and student's learning difficulty become normal. To improve the teaching effect of Sport Statistics, it is very necessary to combine Sport Statistics teaching with network teaching. The multimedia technology is used to display the skills and operations vividly, and present the results in the forms of graph, animation, text, sound and video. Hence, the complex theories and statistical data can be transformed into vivid and simple pictures to help students understand [2]. Meanwhile, the course nature also causes traditional teacher-dominated teaching mode is not suitable for it, because more importantly, students can understand the theory of Sport Statistics, apply the skills of Sport Statistics, analyze random phenomena of sports and draw conclusions. The student-centered teaching mode is not suitable, too, because knowledge structure

and practical skills of the course are too complex, and it is impossible for students to learn by themselves. "Double-subject" teaching mode is a teaching mode which combines the two methods. In the "double-subject" teaching mode, "teacher-dominated teaching mode or "student"-centered teaching mode is chosen and continuously adjusted according to actual teaching conditions. This mode can adapt to the teaching demand of Sport Statistics. Therefore, the students of sports specialty were chosen as the objects of study in this study, and "double-subject" teaching mode was used to teach Sport Statistics. Course quality evaluation was combined, and a new Web-based online courseware making platform system was applied to explore the function and effect of "double-subject" teaching mode in the course of Sport Statistics.

2 State of the Art

Network course is mainly based on the fast-developing information and computer technology, and the information interaction mode turns to bidirectional flow from unidirectional transmission. Network course mainly experiences three stages: unidirectional transmission, asynchronous bidirectional flow, and synchronous bidirectional flow [3]. At present, China pays more and more attention to network courses which gain rapid development together with network technology. Li [4] studied the application of network courses in college ideological and political education, explored how the traditional education mode should cope with the overwhelming network course teaching mode, and indicated that network courses have significant effect on improving college teaching level. Thus, college education should adjust strategies, and bring network courses in teaching. Du et al. [5] took "personal finance" network course as the case to carry out evaluation research on network course quality, including network course design thought, network course objective setting, and influencing factors of network courses, and indicated that students' learning enthusiasm and learning effect were obviously enhanced after the network course was introduced. Yang [6] probed into the application of network courses in college English teaching, and indicated that a new teaching thought designed by combining network education with internet + could meet students' increasing learning demands. Wang [7] also investigated the application of network courses in modern teaching, and indicated that the integration of internet + thought and education could change teacher's ideas, improve teaching quality and provide high-quality talents for the society. There are also some foreign researches on network courses. For example, a learning research center in US conducted evaluation research on a lot of network courses and indicated that network courses could well change students' learning attitude and satisfy their learning needs [8]. American Institute of Higher Education [9] evaluated network courses as per online learning quality standards, and found that network courses can indeed improve students' learning enthusiasm and students are also satisfied with network courses. Vella et al. [10] conducted the teaching experiment in mid-sized public university in the northeastern USA, and found the network courses combining the mixed teaching mode has the better teaching effect than the independent network courses. Dawson et al. [11] used Knowles's framework, implemented the learning tasks and themes of

network courses in social work education and constructed an online environment in a social work school. It was found that, the network course more contributes to solving teaching problems. Although there are certain domestic and overseas studies on network course and network course evaluation, the fields involved are not very wide, and most studies are case studies in the fields that researchers are interested in. in the field of physical education, the researches on multimedia teaching are nor very common, and there is almost no network course teaching research for Sport Statistics.

Thus, the innovation points of this study are as below: firstly, double subjects were applied in Sport Statistics, and the "teacher"-dominated teaching mode and "student"-centered teaching mode were combined. The teacher and students are the "double subjects". Secondly, Web-based online courseware making platform system was applied in Sports Statistics, and Sports Statistics courseware exchange and sharing were achieved. Besides, a lot of resource materials were provided. Thirdly, the above network course teaching mode for Sports Statistics was evaluated to practically grasp the effect of "double-subject" teaching mode on Sports Statistics.

3 Constructivism-Based "Double-Subject" Teaching Design Mode

3.1 Constructivism-based teacher-dominated and student-centered teaching design process

Traditional teaching mode is generally "teacher"-dominated or "student"-centered. In the "teacher"-dominated mode, the teacher becomes the leader, and students learn passively. Thus, students' learning initiative is not high. They will only apply knowledge, and cannot create. Although the "student"-centered mode gives full play to students' autonomous right and can promote students' creation ability and learning ability, it excessively ignores teacher's function, and students are too free, without supervision, restraint and guidance, thus leading to the low learning efficiency. Hence, "double-subject" teaching mode is very necessary, which combines "teacher"-dominated mode or "student"-centered mode, adopts the strengths and avoid the shortcomings of "teacher"-dominated mode or "student"-centered mode. Firstly, the process design is conducted for the "teacher"-dominated mode or "student"-centered mode. For the teaching design process of "teacher"-dominated Sport Statistics, the teacher first determines the teaching objective of Sport Statistics, then analyzes the objective, analyzes students' features and confirms the teaching starting point of each lesson of Sport Statistics by combining the above process. Then, network course selection and Sport Statistics teaching media are combined for teaching strategy design. In the end, Sport Statistics teaching evaluation forms. In this process, the above teaching process can be properly modified and adjusted according to the evaluation fed back. In the "student"-centered teaching design process of Sport Statistics, the teaching objective is firstly analyzed, and then situation creation is conducted. The situation is combined to provide information resources for students, help them design independent study strategy and assist them in designing the learning environment.

Then, students' learning effect is evaluated, and intensified exercise design is carried out for students, as shown in Fig.1 and Fig.2.
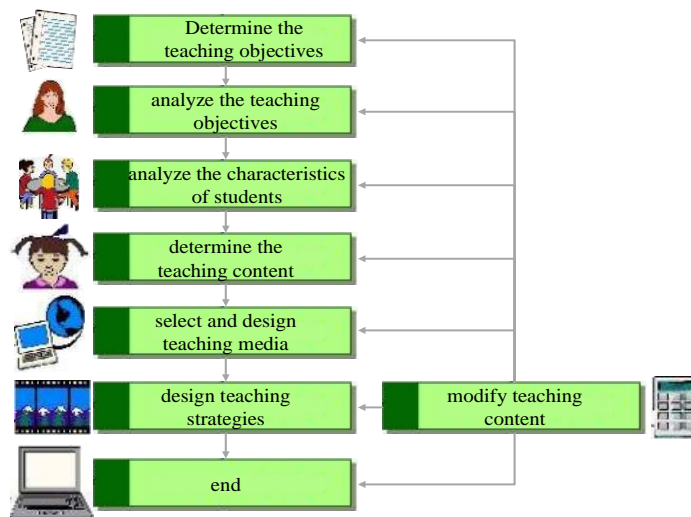
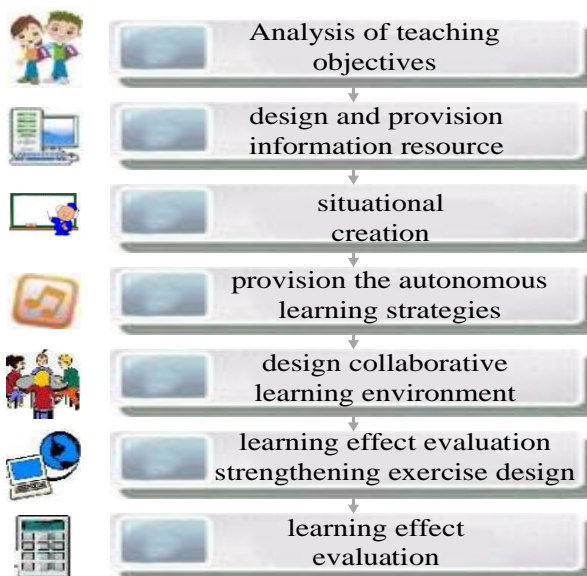**Fig. 1.** "Teacher"-dominated teaching design process

Fig. 2. "Student"-centered teaching design process

3.2 Constructivism-based "double-subject" teaching design mode

Based on the above "teacher"-dominated or "student"-centered course design process for Sport Statistics, the "double-subject" teaching design mode is constructed. In the specific teaching process, "teacher"-dominated mode or "student"-centered mode is chosen according to actual teaching conditions. First of all, teaching objectives, students' features and teaching contents are analyzed, and the teaching modes are selected according to the teaching theme, students' knowledge structure and cognitive competence. If "teacher"-dominated mode is adopted, the advance organizer is firstly confirmed. Then, teaching media are chosen according to the requirements of the organizer and learning theme. Next, the teaching content and organization strategy are designed. Finally, the evaluation forms. If "student"-centered mode is adopted, the zone of proximal development is firstly confirmed, and then students enter the situation, explore independently and evaluate the learning effect. No matter which teaching mode is chosen, effective knowledge transfer should be promoted, as shown in Fig.3.
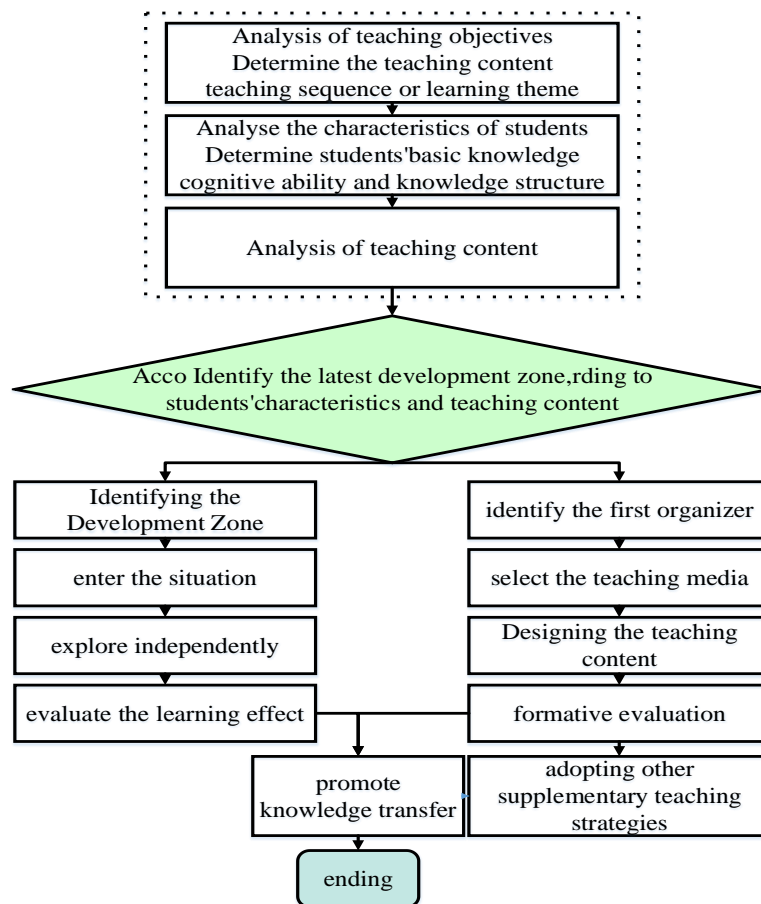

Fig. 3. "Double-subject" teaching design mode

3.3 Working process of double-subject teaching mode combining online course system

Working process of analysis stage: The analysis of Sport Statistics teaching objective involves subject objective, unit objective, period objective, and teaching objective, etc. First of all, the objective of each unit is confirmed according to the overall objective of Sport Statistics. Then, the period objective is determined according to unit goals. In the end, the teaching objective is determined according to the period objective. The details are shown in Fig.4.
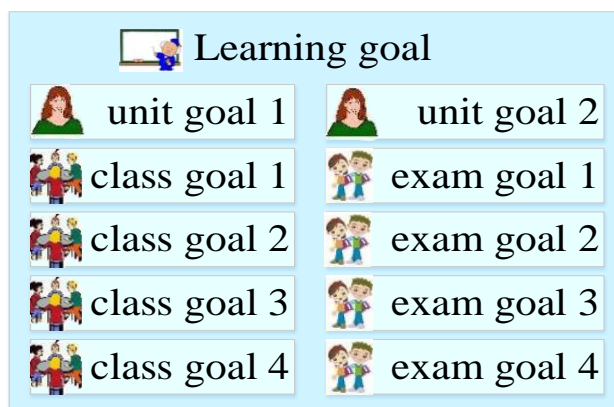

Fig. 4. Design process chart of teaching objective

Analysis of students' features: The features of Sport Statistics students are analyzed from two aspects. The first one is students' initial level which is mainly used to judge whether the students own the necessary learning ability and which improvement measures can be provided, i.e. the ready ability. The other one is students' cognitive structure, from which students' cognition of Sport Statistics is mainly known, i.e. target ability. Both can be tested by test questions, as shown in Fig.5.
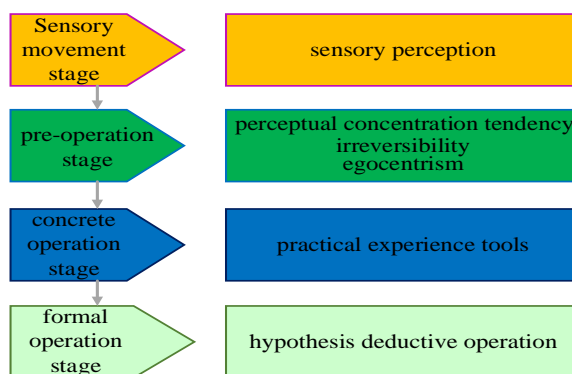

Fig. 5. Design process chart of students' feature analysis

Working process of teacher-dominated teaching branch: The advance organizer is confirmed. The teacher applies the previous learning materials of Sport Statistics to link, integrate and explain current learning task to promote new knowledge maintenance and change of students' cognitive structure. Firstly, current learning content is studied, including the new concept, knowledge and proposition, etc. Then, students' learning foundation is studied, including the old concept, knowledge and proposition, etc. The link between the two is confirmed.

Design of organization strategy of teaching content: The teaching content of Sport Statistics is organized, like how to sort the teaching order, and how to design the specific teaching activity. Firstly, the relations among learning contents are investigated, including generic relationship, summarization relationship, and parallel relationship. Secondly, the type advance organizer is confirmed, like superior, inferior or parallel organizer. Finally, the organization strategy is determined, such as superior, inferior or parallel organization strategy.

Application of a new double-subject online courseware making method: The Web-based online courseware making method is used as the network teaching media of Sport Statistics under "double-subject" teaching mode to produce Sport Statistics network courseware. The courseware can be operated in Chinese, and can support online course courseware production and offline playing, store massive teaching materials hierarchically, provide copyright protection for these materials and provide personalized knowledge recommendation service and knowledge sharing for learners. The production method mainly includes sever side and client. The server side contains personalized recommendation engine, Web server, database server, log storage, analysis server and material library. The client contains portal website and courseware making platform, as shown in Fig.6.
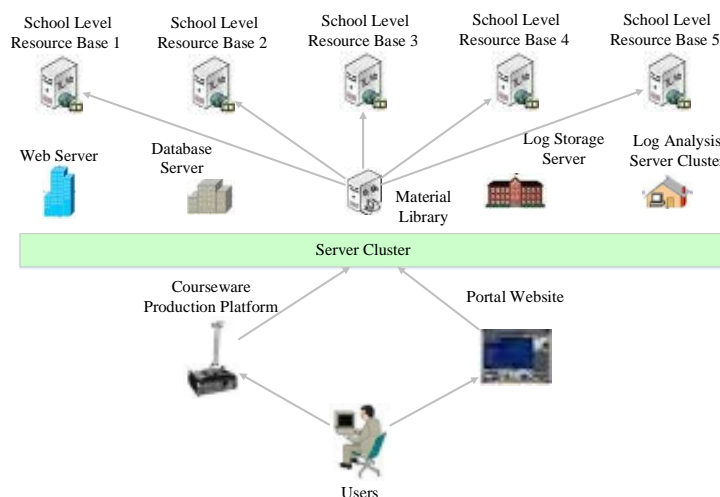

Fig. 6. Double-subject online courseware making method

3.4   Effect evaluation of Sport Statistics network course based on double-subject teaching mode

The evaluation model of Sport Statistics network course involves 7 aspects, including teaching content U_1, teaching design U_2, course resource U_3, page design U_4, technical force U_5, teacher as the subject U_6 and user experience U_7.

Confirmation of evaluation set: 5-level evaluation method is adopted. The higher level indicates the higher level and quality of Sport Statistics.

$$V = \{V_1, V_2, V_3, V_4, V_5\} = \{\text{Level 1, Level 2, Level 3, Level 4, Level 5}\} \tag{1}$$

Calculation of evaluation index system weight: AHP computing method is adopted, Satie's 1-10 importance level index assignment table is combined to compare indexes and gain the comparison values among indexes so as to confirm the importance. Besides, consistency check is used to determine the weight setting rationality.

$$CI = \lambda_{\max} - n / n - 1, \lambda_{\max} = \left(\sum (BW)_i / W_i\right) / n$$
$$\sum (BW)_i = B_{i1} \times W_1 + B_{i2} \times W_1 + ... + B_{i7} \times W_1 \tag{2}$$

W_i refers to weight coefficient of each index to the overall indexes; $\lambda_{\max}$ is the maximum value in pairwise comparison; $\sum (BW)_i$ is the numerical value calculated by summing the products between the importance level coefficient gained after each level-1 index is pairwise compared with other level-1 indexes, and the weight of level-1 indexes to the overall evaluation index system.

Establishment of evaluation factor model: Firstly, the evaluation matrix R is set up, and the comparative results of indexes correspond to each other. There are still 5 levels. R_{ij} means the ith index corresponds to the level j.

$$R = \begin{Bmatrix} r_{11}, r_{12}..., r_{1m} \\ r_{21}, r_{22}, ..., r_{2m} \\ ..., ..., ..., ... \\ r_{71}, r_{72}, ..., r_{7m} \end{Bmatrix} \tag{3}$$

Secondly, fuzzy comprehensive evaluation. The weight coefficient is figured out through the weight calculation formula. The evaluation matrix W of weight coefficients forms. Then, W and R multiply to gain the fuzzy evaluation result of network course evaluation model.

$$W \times R = W \times \begin{Bmatrix} r_{11}, r_{12}..., r_{1m} \\ r_{21}, r_{22}, ..., r_{2m} \\ ..., ..., ..., ... \\ r_{71}, r_{72}, ..., r_{7m} \end{Bmatrix} \tag{4}$$

4 Teaching Example and Effect

4.1 Teaching example

"Demonstration – imitation" teaching strategy and "problem – inquiry" teaching strategy were designed by taking Sport Statistics for example. "Demonstration – imitation" teaching strategy is dominated by "teacher". The teacher demonstrates the function skills and operation to students, displays the effect and specifies the requirements. Then, students practiced repeatedly, finally mastered knowledge proficiently and achieved knowledge transfer. "Problem – inquiry" teaching strategy is dominated by "student". It follows the thought of learning problem – discovering problem – analyzing problem – solving problem, and takes problems as the center. Students' independent discovery of problems is the key, and the teacher plays a role of leading. The details are shown in Fig.7 and Fig.8. Fig.9-10 show the application of double subjects in online courseware making software.
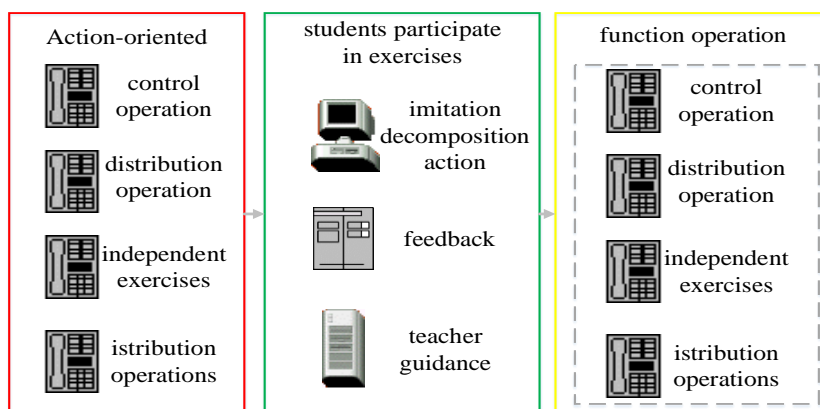

Fig. 7. Design scheme of "demonstration – imitation" teaching strategy
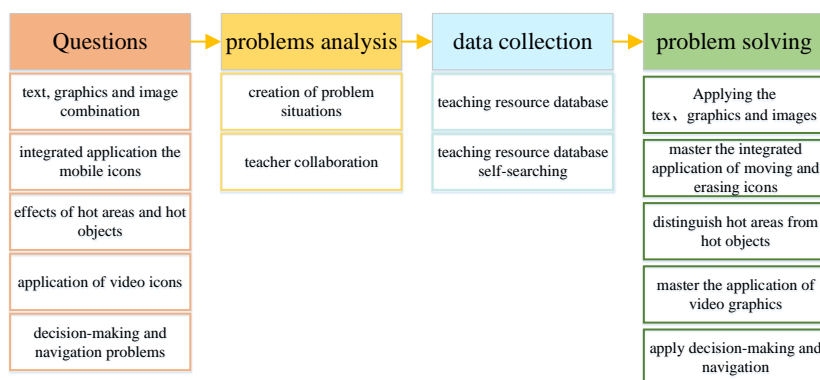

Fig. 8. Design scheme of "problem – inquiry" teaching strategy

Table format: **Grouped**		Group A			Group B		
		RCC			Adjacent tissue		
	[×]	A:Y1	A:Y2	A:Y3	B:Y1	B:Y2	B:Y3
1	Title	10.53	10.78	10.71	3.25	3.56	3.31
2	Title	4.75	5.18	4.78	12.30	13.42	13.32
3	Title	6.60	6.82	6.26	9.26	10.18	9.63
4	Title	10.86	11.91	11.90	11.97	12.84	12.25
5	Title	9.59	9.71	8.79	15.78	17.11	15.48

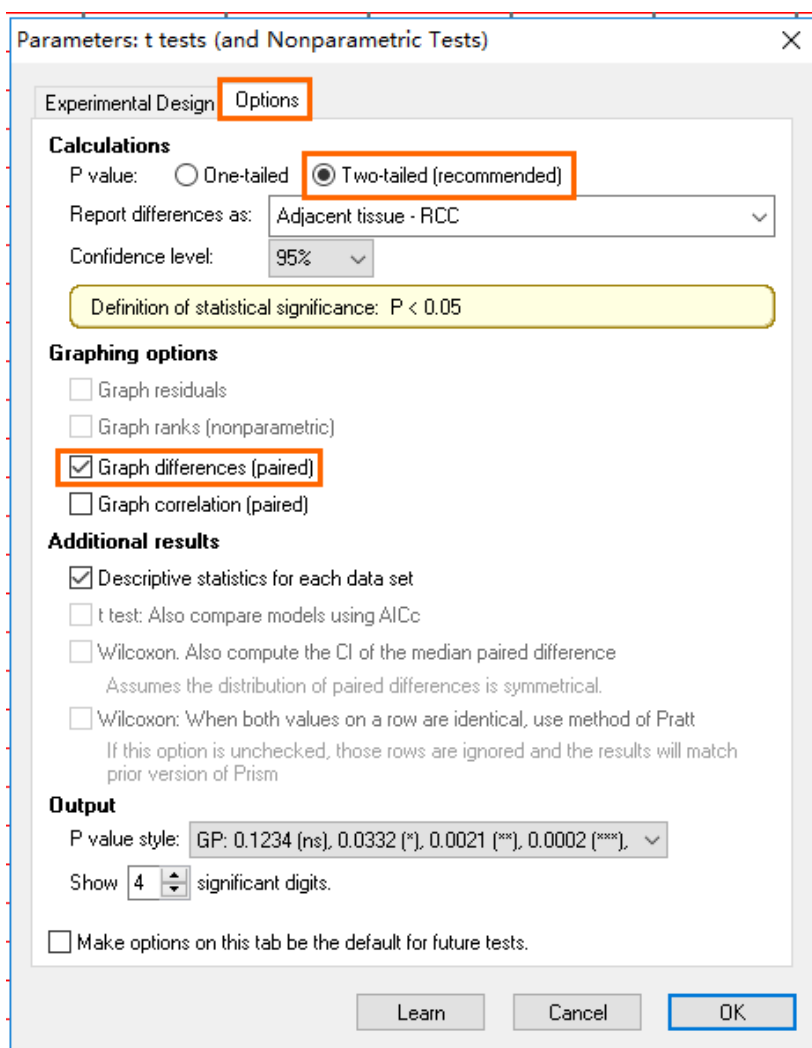**Fig. 9.** Application link I of double-subject online courseware making software

Fig. 10. Application link II of double-subject online courseware making software

4.2 Teaching effect

Two classes were chosen for the teaching experiment of double-subject teaching model, and classified into experimental class and control class. The teaching effect was judged by questionnaire survey, as shown in Table 1.

Table 1. Teaching effect evaluation table of two classes

Item	Control class	Experimental class	x^2	p
Like such teaching mode	56(64.23)	80(91.09)	13.53	0.044
Motivate learning interest	50(56.77)	75(85.08)	11.76	0.035
Improve generalization and summarization ability	58(66.88)	76(86.45)	12.87	0.014
Cultivate self-learning ability	52(58.98)	78(88.55)	14.56	0.027
Improve verbal expression ability	50(56.77)	68(77.23)	10.88	0.041
Enhance the ability to analyze and solve problems	57(64.91)	72(81.76)	11.32	0.030

It can be seen from Table 1 that, the students in the experimental group are better than the control group in six aspects: attitude to the teaching method, learning interest motivation, self-learning training, improvement of generalization and summarization ability, enhancement of verbal expression ability, and enhancement of the ability to analyze and solve problems. Through chi-square test, they are significant at the level of 0.05, and the differences have statistical significance. Meanwhile, the average score of experimental groups in the course of Sport Statistics is 86.67±9.08, significantly higher than that of control group (70.44±12.21). t test result is 5.22, and p is less than 0.05. There is also statistical significance.

5 Conclusion

In this study, the students of sports specialty were chosen as the objects of study, and double-subject teaching mode was adopted for teaching practice. Besides, course quality evaluation was combined, and a new Web-based Online Courseware Making Platform System was applied to carry out teaching experiment for the students. The function and effect of "double-subject" teaching design mode in Sport Statistics were evaluated. The results show that the teaching mode can significantly improve teaching performance of Sport Statistics, motivate students' learning interest, improve students' verbal expression ability, generalization and summarization ability and self-learning ability, and strengthen students' ability to analyze and solve problems. It has significant positive influence on Sport Statistics teaching and obvious advantages. However, this teaching mode puts forward higher requirements for teachers, including how to make high-quality network course teaching courseware, how to smoothly stimulate students' learning interest and how to correctly guide students to learn independently. All these are the key problems that the teacher must consider when apply-

ing double-subject teaching mode combined with network courses in Sport Statistics teaching.

6   References

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