The Exploration and Practice of University Online Assessment Based on RPV Framework

HU Xiao-han[a], ZENG XIN[a*], JIANG Ai-ping[a]

Abstract: As an important part of online teaching activities, "online assessment" is of great value in achieving the goal of "substantial equivalence". From the perspective of online "learning assessment" of course, this article studies and analyzes the process assessment, formative assessment and summative assessment. It focuses on the analysis of the key points of management and organization in the online assessment, and combines with the RPV framework to study the innovation elements and innovation paths. The article proposes an online assessment model that takes the value co-creation of the faculty team as the cultural guidance, takes the content design, the technology application, and the organization innovation adaptable to online situation as the path, and takes the diversified and integrated organization and management process of online assessment as the guarantee.

Keywords: colleges and universities; online assessment; RPV framework; substantial equivalence

Introduction

At the beginning of 2020, the COVID-19 epidemic has brought a great challenge to the whole country, and people are united in their efforts to respond to this emergency. With a high sense of responsibility and a strong sense of mission, the national education system has been involved in the fight against the epidemic, with "all for the lives of teachers and students" as the priority. On February 5, the Ministry of Education issued the "Instructions on Doing a Good Job in the Organization and Management of Online Teaching in General Colleges and Universities during the Period of Epidemic Prevention and Control", which requires joint implementation and guarantee of online teaching in colleges and universities during the epidemic prevention and control period, so as to achieve "Suspension of classes without stopping teaching, suspension of classes without stopping school"（Ministry of Education,2020）.

In order to implement the relevant requirements of the Ministry of Education, colleges and universities all over the country have made preparations for online teaching and online learning. After mid-February, the spring semester began to start and the online teaching activities were implemented. The orderly development of multi-platform and multi-mode online teaching

activities, such as "National Excellent Online Open Courses", "Recorded Lessons", "Live Broadcasting" and "National Virtual Simulation Experiment Sharing Platform", not only enhances the connotation of college teaching, but also expands the extension of higher education （Yu&Wang,2020）.

Educators take active actions and promote the orderly development of "online learning and online teaching" with wisdom and action. Meanwhile, how to achieve the goal of "substantial equivalence" of online teaching has also become the main current problem (Kebritchi et al.,2017). This article will base on the "learning assessment" in online teaching, analyze and discuss multiple assessments, and combine the typical cases of online teaching and online final assessment practice in the early winter semester of 2020 in SILC Business School, Shanghai University[b], and it focuses on the key points of management and organization in the online assessment, analyzing the behavior and performance of different participants in combination with the RPV (resource-process-value) model, then provides suggestions for the implementation of online assessment.

1.Course assessment in the context of online teaching

As an important part of course teaching, course assessment is a process to evaluate the goals set by each course to test and analyze the effects of

[a.] SILC Business School, Shanghai University, Shanghai 201800, China.
*Corresponding Author: ZENG XIN, Email: 18800362516@163.com
[b.] Hereinafter referred to as "SILC"

teaching and learning (Baleni,2015). The assessment for course objectives usually includes formative assessment, process assessment and summative assessment (as shown in Table 1). When online teaching is carried out on a large scale, course assessment also endows innovative capabilities.

Formative assessment is an evaluation of students in the process of teaching, which is carried out in real time, dynamically and repeatedly. It focuses on timely feedback to strengthen and improve students' learning (Ogange et al.,2018). Students can understand the gap between their own learning situation and the ultimate goal during the learning process, and clarify the direction of their efforts. Meanwhile, teachers can learn about students' situation and improve teaching in time through feedback (Wang,2018). The related research on formative assessment in domestic and foreign literature basically follows the characteristics of formative assessment of "inferring the effectiveness of students' learning and providing teachers with timely teaching-learning feedback" (Pan&Xian,2018).

As Bloom said, "the main purpose of formative assessment is to determine the degree of learners' mastery and the part that has not been mastered. Its purpose is not simply to grade or identify learners, but to help students or teachers focus on the learning activities necessary for further improvement" (Guskey,2005). During the period of epidemic prevention and control, colleges and universities have made full use of various online teaching platforms to provide a natural stage for formative assessment. The automatic test of the platform uses an electronic response system to diagnose learners' knowledge mastery, and provides strong technical support for formative assessment by continuously strengthening the interaction and timely feedback (Ge et al.,2019). Intelligent online learning platforms such as "Superstar", "Rain classroom" and "Wisdom tree" can set up pre-class preview, interactive feedback in class and after-class data summary, and they use online evaluation tools to realize the assessment and feedback of content and progress for the whole process of students' learning, so as to give a comprehensive formative assessment of students' learning, and with the help of platform data, to provide effective support for paying attention to students' methods, attitudes and needs in the learning process.

Before each course, teachers can release the requirements of course preview, autonomous learning and topic discussion to students through the learning platform, so that students can come prepared. Through the background information of the learning platform, teachers can grasp the situation of students' self-study and preview before class, and arrange the content of online interactive class while effectively reminding them; in classroom teaching, teachers can release classroom tests through the online learning platform to give immediate feedback on the learning effects of key content, and also online student-student interaction and teacher-student interaction can be formed with the help of online activities such as "group discussion", "topic discussion" and "rushing to answer", so as to enhance the participation and cognition in the learning process; after the course, the online learning platform data is used to establish effective learning analysis for students, and it will form a complete formative assessment by assigning online homework or tasks of course reflection (Khairil & Mokshein, 2018; Pezzino, 2018).

Process assessment belongs to the assessment of classroom learning and is a developmental assessment method. It compares different aspects of students' self-development and individual relevance, and should reflect the interaction between the subject and object, which needs to involve the academic evaluation elements for group process evaluation. The group evaluation has the characteristics of procedural, record-style, comprehensive evaluation and high evaluation credibility (Wu,2006; Seifert & Feliks,2019).

Online teaching platform provides a wealth of tools, using semantic analysis technology, through quizzes or periodic examination to achieve process assessment, to help learners better understand the learning situation. For example, Superstar platform introduces peer-evaluation mechanism in "group discussion" and "PBL" learning activities, which provides a good mechanism guarantee for the implementation of process assessment. Teachers set up group tasks in the system, and make mutual evaluation rules. Students submit tasks within the specified time and complete the evaluation in accordance with the mutual evaluation mechanism distributed by the system. The system gives the review of results and realizes effective process assessment.

Summative assessment is a relatively classic evaluation method, which evaluates students' learning ability and courses' teaching quality according to the examination results. This kind of assessment is carried out at the end of a learning period (Gikandi et al.,2011). Therefore, the final exams are usually used to evaluate the knowledge

and skills that are easy to quantify in the learning content. During the epidemic prevention and control period, the implementation of online (large-scale) final assessment will promote the "substantial equivalence" of online teaching.

Online examination usually has two application scenarios. One is that as an independent system, it serves for examination, such as GRE, computer grade examination, and various attestation examination; the other is an important component of the school's online learning platform, which serves the course examination of online education (Li,2020). The latter serves teaching, so the content and system are more suitable for course assessment in online teaching, but it still needs to be combined with "soft" environment in terms of function and technology.

2. Analysis on the innovation path of online final assessment management and organization based on RPV framework

In "The Innovator's Solution", Christensen disassembled organizational capabilities into three aspects: Resource, Process, and Value, namely the RPV framework (Christensen&Raynor,2013), as shown in Figure 1. The modalities decided by these three are the reasons why different organizations have different performances in the face of innovation. Compared with traditional offline assessment methods, online assessment will inevitably bring new requirements to organizational capability innovation. Based on the framework of RPV, the key elements of online assessment are analyzed systematically, so as to realize the effective innovation of organization management and implementation (Feng et al.,2019).

2.1 Innovation of key resource elements in online assessment

The examination resource in online assessment should be rich and diverse. The assessment content, assessment technology, and assessment organization form have become the key resource elements in the online examination. The changes and adjustments they make in the online context provide an inexhaustible source of power for the realization of online assessment.

First, the content design of the assessment adapts to the online context. Under the premise of ensuring the accuracy and clarity of the assessment objectives, the person in charge of the course adjusts the content of the examination by adopting methods such as "partly open book", "open book", "closed book with large amount of questions" and other methods. For example, in the "Business

Statistics" course, which is highly popular among students of SILC, the teachers boldly tried to adopt an open and self-proposed test in the final examination to realize students' self-assessment and self-examination.

In the final examination, the teacher provided a general background: in the face of COVID-19 that is raging this year, the virus test is very important. At first, the hospital used lower respiratory tract test, but the result was sometimes inaccurate. Some of the subjects still showed negative results after more than 20 tests of the lower respiratory tract, but in fact the subjects already had COVID-19. So, someone later proposed an upper respiratory tract test method. Then the students will be asked to put out a question about the difference test of double population mean according to the background, and the quality of the question accounts for a certain score. The sample size, significance level, threshold method (or p-value method), hypothesis testing method (left side test, right side test, bilateral test) or interval estimation method are specified by the teacher, and also the requirements of sample size, significance level and so on were different for students with different ending numbers. Students are allowed to use statistical software (such as SPSS, SAS, EVIEWS, etc.) or their own programming (C, C + +, python, etc.) to solve the problem, but each step of the operation should be shown by screenshots.

Secondly, the rules design of assessment questions adapts to online context. Multiple-choice questions are a common type in the final assessment, especially suitable for course examinations with a rich question bank. The automatic marking function of the platform greatly improves the efficiency of the examination. Taking the Superstar learning platform as an example, its test module can ensure that each class has 20 random test papers, and the random test papers of different classes are not repeated. When it issues the random test papers, you can choose to disrupt the order of questions and the order of options to further improve the effectiveness of multiple-choice evaluation.

Furthermore, the examination rules are designed for online situations. In the final assessment that uses objective and subjective questions at the same time, the examination rule of issuing questions in stage and closed loops can be adopted, that is, the first part of the objective questions is issued first, and the second part of subjective questions is issued after all students have submitted all the questions within the specified time. The subjective questions in the online

assessment are usually open and computationally complex questions with certain difficulty. For example, in the final assessment of "Econometrics", answering comprehensive questions requires a large number of formulas and mathematical symbols, then the teacher asks the students to write on paper, then take pictures and upload them as an attachment.

Online assessment technology is also a key resource element, which is mainly manifested in the technical complementarity and support between the examination function of online teaching platform (invigilator and data tracking) and external auxiliary equipment (dual cameras).In order to create a closed environment for the online closed-book examination, the online teaching platform usually has "invigilation", but it is also limited to the background statistics for students entering or exiting the online examination interface. Therefore, it is usually necessary to add peripherals in the online closed-book assessment. For example, let students prepare another device and turn on the Zoom invigilator (the camera is on the side of the student, and you need to be able to see the student's screen and upper body), and you can require each student to turn on screen recording. Some online examinations also require students to record the whole process of the test by computer, creating a good examination environment and improving self-discipline.

2.2 Key process elements innovation of online assessment

Compared with the original offline assessment, the online final assessment shows the characteristics of more complex examination organization and management process, complementary and diverse responsibilities of the participants, and integration of multiple communication channels (Rahim, 2020).

First, the organization and management process of online examinations needs to be divided into at least four stages: preparation period, simulation period, progress period, and feedback period. The simulation period is not only a characteristic stage of the online examination, but also a very important link to ensure the implementation of the assessment.

Secondly, in addition to the teachers and students, the participants of the online examination also include educational administrators, counselors, and platform technicians. They perform their duties in each link to effectively ensure the orderly progress of the examination, such as Table 2 shows.

The key factor for the success of online

assessment lies in the organizational process innovation with multi-stage and multi-subject participation. In the process of multiple-subject interaction and collaboration, students and teachers, teachers and course leaders, course leaders, educational administrators and external platform technicians are problem-oriented, through multiple rounds of two-way interaction, communication and collaboration, a common understanding of online teaching and assessment has gradually formed, which in practice nurtures the innovative development of organizational culture (Wang&Chen,2015).

2.3 Use value identification to activate organizational culture and promote the realization of innovation goals of online assessment

Value is the core of organizational culture. The change of final assessment from offline to online seems to be a change of working situation, but it actually brings a good opportunity for the inheritance and innovation of organizational culture. It can be seen from the process innovation of the online assessment that the interactive collaboration and co-creation of multiple subjects realizes the process guarantee for the implementation path of online assessment. In this process, the concept and ideological identity formed by teachers, employees and students in multiple interactions are the source of value for online assessment.

As the leader of value co-creation and innovation, educational managers often play the role of spiritual leaders facing innovation and change. First of all, they need to fully understand and agree with the concept of online assessment, have a "compassion" with the course leader, and be able to relieve the "ideological pressure" for practitioners of online assessment through effective communication; Secondly, it is necessary to sort out the key links of online assessment in an orderly manner, fully "authorize" the teachers, and trust them in the professional ability and quality of the course assessment; Finally, we must take advantage of the opportunity to mobilize the enthusiasm of all participants, encourage every small change and practice with a cherished and appreciative perspective, activate potential through team interaction, and achieve collective empowerment.

Any participant, whether it is a teacher, a student or an administrator, also cherishes the various opportunities brought about by the new changes, and uses their professional expertise to

innovate work, improve efficiency, and empower self-development. For example, during the simulation period, teachers found that the answer types of fill-in-the-blank questions are diverse and complex, and then changed them into subjective questions in the final examination, which is convenient for manual marking; Teachers are constantly exploring ideas in trying to use online examination technology tools, such as the setting of "disordered topics and options" and "automatic submission"; Educational administrators deduce "personnel invigilation" and "machine invigilation" in online assessment; Counselors remove psychological barriers for students through a variety of ways, so that they are optimistic and positive to meet the online learning and assessment; Teachers prepare detailed online test preparation notes for students; The self-discipline, awe, and respect

formed by the students in online learning and online assessment have subtly established the cultural characteristics of "embracing change and being positive" for the organization in the special period, allowing each participant to achieve "self-empowerment" in this process.

3. Online assessment practice of SILC, Shanghai University

There are 30 courses for undergraduates in the winter semester of SILC, of which 8 courses are arranged for online examinations this time. The online courses are mainly compulsory courses for sophomores of the college. A total of 1659 students have participated in this online examination (including 130 international students) (as shown in Table 3).

3.1 Preparations before the examination
3.1.1 Arrange simulation tests before the examination.

To organize multiple rounds of simulation test one week before the formal examination to ensure that all students participate in the simulation test, including: question distribution, network check, and students' submission of test papers, etc.

3.1.2 Distribute documents about the Notes for examinees.

According to several rounds of simulation test in a week, the "Notification for the online final examination of SILC in winter semester" is distributed to students before the examination. Including: students should enter the classes of each platform at least 30 minutes in advance, waiting for the beginning of the examination; Students are not

allowed to join the examination once it has started for 20 minutes (automatically set by the system), and other examination disciplines, etc.

3.1.3 About the online examination invigilation work.

On the day of the examination, arranging for an educational administrator to enter the class to invigilate, to master whether the entire examination is running normally, including: for students who have not received the test papers after the test started, the invigilator will immediately contact the counselor to find out the reasons (if the student can enter the platform test within 20 minutes); Keep in touch with the teacher at any time during the invigilation process. If there is a platform network problem, the educational administrator will immediately contact the Superstar technician to solve it; If the educational administrators find that students frequently cut out on the platform, they should immediately feed back to their counselors, let them know the situation, and remind the students to take the examination discipline seriously.

3.2 Implementation form of online assessment
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3.4 Implementation form of online assessment
3.3 Online assessment results

The result of online assessment is compared with that of traditional offline assessment, as shown in the table5 below.From the above score distribution in table5, it can be seen that the proportion of students whose scores are in the 80-90 zone on the online assessment is higher than that of the offline assessment, and the scores of the students on the online assessment are lower than the offline assessment when the score is below 70 points. For the seven courses, from the perspective of the distribution, trend and average of student scores in the online assessment, the performance of the students in the online assessment and the offline assessment is substantially equivalent.

4. Discussion

Based on the practice of online teaching and online assessment under epidemic prevention and control, this article points out that online teaching, supported by the intelligent platform, effectively promotes the implementation of formative assessment and process assessment in course assessment. For the summative assessment that focuses on the final assessment, it is necessary to innovate in key elements and paths. With the help of RPV innovation framework, this article proposes an online examination mode, which takes the value co-creation of teaching team as the cultural guidance, the application of assessment technology and the organization form innovation of assessment adapted to the online situation as the path, and the diversified online examination organization and management process as the guarantee. At the beginning of April 2020, the SILC of Shanghai University completed the online final assessment on 8 courses for 1659 students. Comparing with the data of offline final assessment over the years, the score distribution of online final assessment is consistent and reasonable, which further verifies

the "substantial equivalence" of online teaching and online assessment.

The current study has several implications for the literature: (1) It enriches the application fields of RPV theoretical framework. The RPV framework is introduced into the research of online assessment in colleges and universities, which forms the innovation path of online assessment in colleges and universities based on the perspective of RPV, and widens the application boundary of RPV theoretical framework. (2) It further enriches the content and application value of online assessment in colleges and universities. The article studies resource innovation from the aspects of online assessment content, technology and organization form. It studies the management points from four periods of online assessment preparation period, simulation period, progress period and feedback period, and studies cultural elements from different roles of teachers, students and managers, which provides theoretical support and basis for assisting the reform and practice of the assessment in colleges and universities. Theoretical implication of the current study further leads to the valuable practical implications: (1) It promotes the innovative development of online assessment in colleges and universities, and further enrich the development direction of online assessment in the new era. Especially under the influence of the epidemic, offline education assessment of colleges and universities in some areas cannot be carried out normally, and then the characteristic online assessment is necessary. (2) Taking SILC as an example, the article compares and analyzes the score distribution of online final assessment and traditional offline assessment of 8 courses, verifies the effectiveness of online assessment, provides a reference standard for the practice of online assessment, and has practical significance for the exploration of online assessment in colleges and universities. The limitation of this study is that the sample size is limited, and it has not been able to verify the substantial equivalence of the online assessment based on the RPV framework innovation on a larger scale. Future research can be further explored from a large sample of different universities and different courses.

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Tables and Figures

Table 1. **Classification and characteristics of course assessment**

Course assessment classification	Characteristics
Formative assessment	Multiple and immediate; dynamic feedback;
Process assessment	Comparative and mutual assessment
Summative assessment	Period and result assessment;

Process
Organization innovation of assessment

Resource
Content and technical innovation of assessment

Value
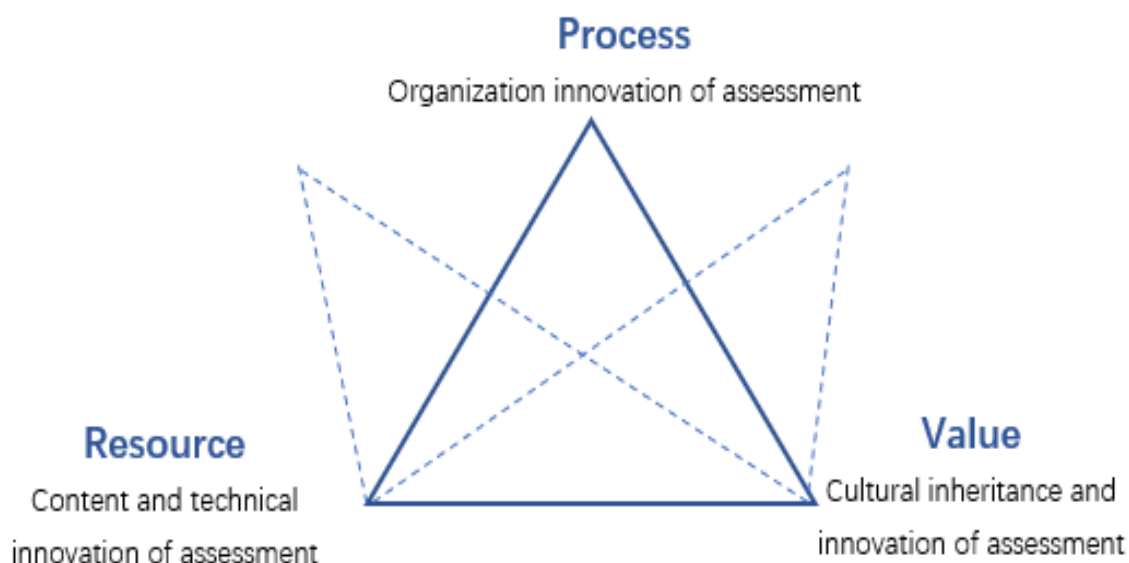Cultural inheritance and innovation of assessment

Figure 1. **RPV framework based on the innovative perspective of online assessment**

Table 2. **Organization and management process of online assessment**

Management process Participants	Preparation period	Simulation period	Progress period	Feedback period
Teacher	Completing the basic setting of question bank and examination;	Implementing the simulation test; Giving examination FAQs	Issuing formal examination; Managing content and process	Online examination paper marking, score submission and examination filing
Student	Understanding online assessment	Familiar with the platform test function, and completing the simulation test	Completing all sections of the online examination required by the course	Reflection
Educational Administrators	Preparing "Online Examination Standard" / "User Manual for Online Examination Platform"	Giving "Notes for Online Examinee"	Online inspection and emergency management	Appeal and handling of special problems
Student Counselors	Preparing "Online Examination Standard"	Distributing "online Examination Standard" and educating students	Online inspection and emergency management	Assisting the educational administrators to deal with special problems
Platform Technicians	Preparing "User Manual of Online Examination Platform"	Supporting simulation operation and optimizing the performance of the platform based on feedback	Online technical support throughout the examination, providing real-time solutions	Summarizing and improving, optimizing the efficiency of the overall examination platform
WeChat Workgroup	Exchanging information among all parties	Key information transition	Emergency handling and timely response	Work experience sharing

Table 3. **The status of the online final examinations for the winter semester of 2019-2020**

Courses	Codes	Number of classes	Number of examinees	Number of international students	Examination date	Examination time	Examination platform
Management and Organization	151950166	273		16	3.30	8:15-10:15	Superstar: SILC
Econometrics	155750873	146		10	3.31	8:15-10:15	Superstar: SHU
Management Accounting	1520500810	495		42		15:00-16:30	Superstar: SILC
Business Statistics	152050164	217		13		8:15-10:15	Wisdom Tree
Management Decisions	151960331	6		4	4.1	15:00-17:00	Superstar: SHU
Economics (1)	155751933	126		0		15:00-17:00	Superstar: SHU
Economics (2)	155751944	254		30	4.2	8:15-10:25	Superstar: SHU
International Trade Practice A	155751233	142		15		15:00-18:00	Superstar: SHU
Total Number of Examinees		1659		126			

Table4. **Details of online assessment of SILC**

Courses	Design form of examination questions	Design form of examination rules	Examination rules	Assessment technology
Management and Organization	Open book	(1) The objective questions and the options are out of order; the time is limited to one minute for a question on average. (2) The subjective questions focus on understanding and application, half of which require students to describe specific theories and discuss their applications; the other half require students to write a self-reflective essay and it's no standard answers. (3) There will be 10 sets of papers respectively for objective and subjective questions.	(1) The two parts will be issued in sequence. Multiple-choice questions and true or false questions in part 1 will be issued first, and the test paper can be submitted in advance after 30 minutes, and this part will end after 40 minutes. Essay questions and discussion questions in part 2 will be open 30 minutes after the test, so that students who answer part 1 quickly can enter part 2 after submitting. (2) Directly type in the answer box. Unless there is an accident with conclusive evidence, we will not accept word/pdf attachments or handwritten photos.	Platform invigilator
Econometrics	Closed book; Open-ended questions	(1) Multiple-choice questions are out of order, and options are out of order. (2) The calculation part of the subjective question is complicated, which makes students have no time to cheat, and the narrative part has no standard answers, preventing all possible plagiarism.	Write the answer on papers and take photos to upload.	Platform invigilation + Zoom invigilation + screen recording
Management Accounting	Open book ; A large number of questions	(1) Mainly objective questions, the questions and the options are out of order. (2)20 sets of test papers are randomly assigned.	The two parts shall be issued and submitted at the same time.	Platform invigilation
Business Statistics	Open book	(1) Open questions. According to different case background, students make their own questions and answer them. (2) As long as the statistical method is correct and the calculation (or statistical software operation) is correct, the corresponding scoring will be given accordingly.	(1) Either choose manual calculation (computers and mobile phones are not allowed), or choose to use statistical software or self-programming (you can bring a computer, and the answers are submitted in word form)	Platform invigilation + screen recording
Management Decisions	Open book	Subjective questions and essay questions without standard answers	(1) Submit answers at regular time and submit them on the Superstar platform. (2) If international students have network problems, submit them in the WeChat group.	Platform invigilation + zoom invigilation
Economics (1)	Closed book	(1) The objective questions are extracted from the question bank; the questions and the options are out of order; (2) Subjective questions are essay questions; there are 20 sets of test papers	(1) The two parts are issued at the same time. (2) The answers to the essay questions must be handwritten and uploaded with photos. (3) If you encounter difficulties in uploading due to the network, you can send it to the teacher by email.	Platform invigilation + zoom invigilation
Economics (2)	Closed book	(1) The objective questions are extracted from the question bank, the questions and the options are out of order, and 20 test papers are distributed randomly; (2) Discussion questions will give the main answer ideas.	(1) The two parts are issued in sequence; the multiple-choice questions of Part 1 are issued first, and then the discussion questions of Part 2 will be issued after 60 minutes. (2) There are three submission methods: you can upload with word / PDF attachment, upload with handwritten photos or send by designated mailbox.	Platform invigilation + Zoom invigilation + screen recording
International Trade Practice A	Closed book	Objective questions are extracted from the question bank, and the questions are out of order.	(1) Multiple-choice questions, true or false questions, and subjective questions are issued at the same time, (2) Directly type the subjective questions in the answer box.	Platform invigilation + Zoom invigilation

Table 5. **The examination results on the online assessment and the offline assessment**

Courses	Assessment Method	>=90分	80~89分	70~79分	60~69分	<60分	Average Score
Management and Organization	online	17.94%	58.02%	19.08%	4.58%	0.38%	83.35
Econometrics	offline	5.02%	59.82%	24.66%	9.13%	1.37%	80.00
Management Accounting	online	38.06%	50.75%	6.72%	2.24%	2.24	86.16
	offline	34.78%	37.68%	13.04%	5.80%	8.70%	80.94
Management and Organization	online	39.78%	34.22%	19.33%	5.78%	0.89%	85.10
Econometrics	offline	29.29%	29.04%	18.94%	12.88%	9.85%	77.74
Management Accounting	online	19.60%	47.24%	21.11%	9.05%	3.02%	80.99
	offline	14.53%	27.37%	22.91%	16.76%	18.44%	70.34
Economics (1)	online	28.575	45.24%	19.84%	4.76%	1.59%	83.70
Economics (2)	offline	24.14%	35.63%	18.39%	16.09%	5.75%	78.84
International Trade Practice A	online	20.72%	55.41%	19.37%	3.60%	0.90%	85.53
Economics (1)	offline	12.385	41.43%	27.14%	13.33%	5.71%	77.30
Economics (2)	online	10.52%	50.02%	25.87%	8.59%	5.00%	83.59
	offline	19.02%	34.78%	29.89%	10.87%	5.43%	78.37