



Main article

The effect of online review exercises on student course engagement and learning performance: A case study of an introductory financial accounting course at an international joint venture university

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ABSTRACT

Prior literature suggests that Chinese students studying in Western Higher Education Institutions (HEIs) tend to underperform compared to local students. Yet few studies have explored the effect of learning and assessment tasks on the engagement and performance of Chinese students who are undergoing a transition into the Western learning environment. We design two online review exercises, which are summative assessments with a formative aspect, for an introductory financial accounting subject and study the effect of these tasks on a group of business students enrolled in the course at an international joint venture university based in China. We find that the online review exercises increase student engagement. Students spent a significant amount of time preparing for the online review exercises both before making their initial attempt and between each attempt. Students undertook a variety of learning activities in completing the online review exercises and their understanding of the subject improved as a result of going through the process. Student performance in the midterm and final exams is positively related to their efforts in completing the online review exercises. The findings are of relevance to accounting educators in both the Western HEIs and traditional Chinese universities who are interested in enhancing the learning performance of Chinese business students.

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1. Introduction

Currently, Chinese students form the largest single country grouping of overseas students studying in Higher Education Institutions (HEIs) in many Western countries, including the US, UK, and Australia (the [Institute of International Education \(IIE\)](#), 2019; [SBS](#), 2019; the [Higher Education Statistics Agency \(HESA\)](#), 2020). The surge in the number of Chinese overseas students enrolled in Western HEIs has stimulated research investigating Chinese students' academic performance. Several prior studies find that Chinese students studying in Western HEIs tend to underperform compared to local students and suggest that this is likely to be due to inadequate English-language skills, prior educational experiences, and cultural difference ([Nield](#), 2004; [McDowall and Jackling](#), 2006; [Wong et al.](#), 2015; [Quan et al.](#), 2016).

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While prior research focuses on identifying possible reasons for the perceived difference in academic performance between Chinese overseas students and Western local students, there is a gap in our understanding about how learning and assessment tasks can be designed to improve course engagement and learning performance of Chinese students studying in Western HEIs. Specifically, we know little about what learning and assessment activities are effective for Chinese overseas students who have a different cultural background and prior educational experiences, and what can be done to cater to and support Chinese overseas students studying in Western HEIs.

Assessment forms a critical element in the learning process and has a fundamental effect on students' learning (QAA, 2006 & 2011). Assessment not only evaluates student performance, but also provides feedback, inspires motivation, and promotes learning (QAA, 2006 & 2011). With the support of online learning platforms, online assessment activities have been widely undertaken in many Western HEIs. Online assessment has several attractive features, including the ability to provide timely and automatic feedback and improve efficiency for large class sizes (e.g., Terzis and Economides, 2011; Ras et al., 2015).

Prior research in accounting education largely focuses on online assessment in the form of multiple-choice questions (MCQs), which typically evaluate learning at lower cognitive levels (e.g., Scouller, 1998). Students only need to select the correct answer from a set of alternatives, and thus are awarded for recognizing the answer rather than constructing a response. Another limitation of MCQs is that the feedback provided through MCQs is often limited and are not personalized to suit different student needs (e.g., Nicol and Milligan, 2006).

In this study, we examine the effect of online review exercises specifically designed for an introductory financial accounting course on the engagement and performance of a large group of undergraduate business students studying at an international joint venture university based in China (the University thereafter) that provides the Western-style all-English learning environment. The exercises are in the form of non-MCQs, integrative questions, covering several topic areas. They are summative assessments with a formative aspect and are designed with an intention to accommodate the characteristics of the students. The results suggest that the online review exercises motivate students to undertake a variety of learning activities and help improve their understanding of the subject.

Chinese students' use of the Internet for learning and assessment pre-COVID-19 has been quite limited (Zhou, 2016). Many traditional Chinese universities did not invest in implementing their online learning platforms and thus online assessment was not typically conducted in such universities. Apostolou et al. (2018) document the lack of empirical studies in the area of technology-enabled learning and assessment in accounting education outside the US and other Western countries. This study fills the gap in our knowledge by providing insights into the effectiveness of online learning and assessment in accounting education for Chinese students who have a different cultural and educational background.

The surge in online education in HEIs due to COVID-19 highlights the importance of learning and assessment design in achieving intended learning outcomes. While the study was conducted pre-COVID-19, it provides useful insights into how online review exercises impact the engagement and learning performance of Chinese business students. The study is relevant to accounting educators in both the Western HEIs and Chinese universities who are interested in designing and implementing online learning and assessment activities to improve student engagement and performance.

The study is structured as follows. Section 2 reviews the relevant literature on Chinese students' learning strategies and online assessment. Section 3 states the background of the study, describes the design of the online review exercises, and discusses the research method. Section 4 presents and analyzes the results. Findings and contributions are discussed in Section 5.

2. Related literature

2.1. Learning strategies of Chinese students

Learning strategies refer to a combination of activities that students use to attain their learning goals (Hartley, 1998).¹ Prior research identifies two main learning strategies: (1) surface learning, which involves simply scraping the surface of the learning material without taking any deep processing of the material (e.g. passively accepting information and ideas, routinely memorizing facts and procedures, etc.); and (2) deep learning, which involves making a serious attempt to truly understand the learning material (e.g., relating ideas to prior experience or knowledge, examining the reasoning of arguments, questioning of alternatives, etc.) (Marton and Saljo, 1976; Entwistle, 1981; Biggs, 1993). High-quality learning outcomes are more likely to be achieved when students have a genuine curiosity in the subject, enjoy carrying out the learning tasks, and take a deep approach to learning (Ramsden, 2003).²

It has been noted that Chinese overseas students in Western HEIs often do not actively engage in class and exhibit a lack of critical or independent thinking and a lack of autonomy in learning (e.g., Watkins and Biggs, 1996; Gieve and Clark, 2005; Wang and Moore, 2014). Several factors might have contributed to the phenomenon.

First, English language ability could affect the learning approach of these students. Gow et al. (1991) suggest that students with limited proficiency in English language are more likely to adopt a surface learning approach. Students who are weaker

¹ Instead of "learning strategy", "learning approach" is often used as a replacement term in the literature (Entwistle, 1988).

² Ramsden (2003) contends that a person cannot be defined as "a surface or deep learner"; instead, one learns the content in "a surface or deep way".

in English are found to concentrate on making sense of the rhetorical aspects of text rather than seeking underlying meaning. Chinese overseas students' lack of fluency in technical English hinders their engagement in class (e.g., Carroll and Ryan, 2005; Wang et al., 2015; Bobe and Cooper, 2019).

Second, prior educational backgrounds may have a profound impact on their preferred learning approach. Chinese students are accustomed to a teacher-centered model of education and expect teachers to transmit information rather than engage them in dialogue and challenge them to think (e.g., Watkins and Biggs, 1996; Wang, 2011). In addition, Chinese students come from a culture valuing collectivism, conformity and respect for authority (e.g., Hosftede, 1994; Triandis, 1995). Little room is left for students to take personal initiative in the context of traditional Chinese learning culture (e.g., Littlewood, 1999). Thus, the transition from the traditional Chinese education system to the Western learning environment, which promotes autonomous learning and critical thinking, can be particularly challenging for many Chinese overseas students.

In the context of accounting education, prior studies examining whether Chinese students have a distinct approach to learning yield mixed and inconclusive findings. For example, Li et al. (2009) claim that Chinese students follow a less active learning strategy and use rote learning frequently.³ However, Patel et al. (2016) find that Chinese students seem to use shallow learning as a way to eventually gain a deeper understanding. In addition, several prior studies suggest that, although Chinese overseas students attending Western universities may initially face many challenges, many of them can adapt to the new learning environment. For instance, Gram et al. (2013) examine a sample of Chinese exchange students at a Danish university in a problem-based learning setting. They find that these students initially experienced a difficult time due to being unfamiliar with such a learning approach but were able to work out coping strategies.

Wong et al. (2015) interview a group of Chinese accounting students with no prior educational experience in Western countries at two Australian universities and find that some of these students, especially those at the entry level, hold a strongly negative view of their learning experience in Australia. They find that the expression of criticism dissipates over time as these students adapt to the new learning environment.

Several prior studies suggest that learning approach adopted by students depends not only on their own culture and individual characteristics (e.g., attitudes, habits, abilities, and personality) but also on contextual factors. Students are found to alter their learning approaches in response to the instructional context (e.g., Volet and Chalmers, 1992; Hartley, 1998; Lucas and Mladenovic, 2004; Gieve and Clark, 2005). Prior research notes that students tend to take a surface learning approach if they feel that there is an excessive amount of material to be learnt and a lack of choice over content and study methods. In contrast, deep learning is more likely to occur when students are given time for reflection and discussion with other students and when the exam tests understanding of principles rather than the reproduction of facts and procedures (e.g., Biggs, 1987; Gow and Kember, 1990). Learning design should aim to stimulate desired learning strategies in order to achieve learning objectives (e.g., Entwistle, 2000).

2.2. Online assessment

Assessment is an important component in the process of achieving intended learning outcomes (QAA, 2006; UKPSF, 2011). Prior studies suggest that what and how students learn are highly dependent on assessment (e.g., Brown et al., 1997). The concept of constructive alignment posits that, when designing learning, instructors need to ensure that objectives, activities, and assessment are well aligned (Biggs and Tang, 2011). This occurs when learning activities are designed to enable students to meet learning objectives, and assessment tasks are designed to examine whether the objectives have been achieved.

Assessment can be summative or formative. Summative assessment is concerned with evaluating student learning at the end of an instructional unit, whereas formative assessment intends to monitor student learning during the learning process and provide ongoing feedback to help students improve their learning (e.g., Boud, 1995). Formative assessment has been found to have a positive impact on students' motivation and performance (e.g., Brookhart, 1997). Summative assessment tasks can be designed to have a formative aspect so that feedback can be timely provided to students to guide learning and offer support (Conrad and Openo, 2018).

Online assessment has been widely applied in Western universities to support the teaching and learning of many subjects. It has been used not only in courses that are delivered purely online but also in courses that are delivered using a blended learning approach, supplementing instruction that occurs in the classroom. It has been recognized as an efficient and effective way for both summative and formative assessments (e.g., Bull and McKenna, 2004). Online assessment allows students to take the test in their own time, to repeat the test on multiple occasions, and to receive timely feedback, and thus can cater to the needs of individual students and engage students with different learning preferences (e.g., Buchanan, 2000). Prior research also suggests that online assessment can enrich students' learning experience by promoting active engagement, stimulating interactions with content, self, and others, enhancing students' motivation, and encouraging students to take responsibility for their own learning, which is a pre-requisite for academic success (e.g., Pachler et al., 2010; Xiong et al., 2015).

³ Li and Cutting (2011) define rote learning as a learning strategy characterized by the mechanical repetition or memorization of material.

The type of questions and the form of assessment are important aspects of online assessment design. MCQs are widely used in online assessment. Prior research provides evidence suggesting that MCQ usage in online summative and formative assessments has a positive effect on student engagement and exam performance in undergraduate accounting courses (e.g., [Marriott, 2009](#); [Einig, 2013](#)). However, some researchers contend that the use of MCQs primarily assesses memorization of factual information instead of higher levels of cognitive skills (e.g., [Scouller, 1998](#); [Marzano and Kendall, 2007](#)).

[Zlatović et al. \(2015\)](#) examine the effect of online assessment on students' learning strategies in a controlled experiment. The results suggest that online assessment in the form of MCQs leads to students taking a shallow learning approach, whereas online assessment in the form of essay questions inspires deep learning.

[Crisp and Ward \(2008\)](#) study the role of online formative assessment in the form of scenario questions in promoting deep learning in psychology.⁴ The assessment evaluates learners' knowledge and understanding by asking them to provide justification for their decisions. Formative feedback is provided with links to supplementary resources. Responses from learners suggest that this form of assessment encourages deep, reflective, collaborative, and autonomous learning.

Little extant research has examined online assessment in the form of non-MCQs in the context of accounting education. The predominant use of MCQs in online assessment is mainly because such questions are automatically graded. The Association of Chartered Certified Accountants (ACCA) and International Association for Accounting Education & Research (IAAER) have called for an exploration of alternative question types in online assessment in order to better assess student competency (e.g., [ACCA, 2010](#)). [Litherland et al. \(2013 a & b\)](#) examine an ontology-based e-assessment system employing semantic web technologies that allows automatic annotation and marking of free-form responses to conceptual questions and provides feedback to students in an undergraduate financial accounting course. They find that the system marks text responses consistently and performs best with grades at the lower and upper ends of the grade range. They suggest that the system affords possibility for changes in assessment practice in the future.

Online assessment design also needs to accommodate student characteristics and the learning and teaching context (e.g., [Tallent-Runnels et al., 2006](#); [Conrad and Openo, 2018](#)). Prior studies suggest factors such as students' English language ability, prior educational experience, and perception about assessment could affect their performance in exams (e.g., [McDowall and Jackling, 2006](#); [Watty et al., 2010](#)). The English competency of students has been suggested to be the most significant factor affecting students' completion of assessment tasks. Students whose first language is not English find it particularly difficult to write essays in an exam setting (e.g., [Watty et al., 2010](#)). Examining a sample of Year 2 accounting students in an Australian university, [McDowall and Jackling \(2006\)](#) find that international students, especially those who enter the university in their second year after obtaining credits for studies completed elsewhere, perform significantly poorer in exams than local students. They suggest that it may be due to transitional issues. They also find that students who perceive computer-assisted learning packages to be useful perform better in the course.

The incorporation of technologies into teaching and learning is a recent phenomenon in China.⁵ Chinese universities have been slower to adopt learning management systems (LMS) compared to Western HEIs. In 2016, Blackboard had only approximately 300 customers in China and Canvas only served a handful of customers in Hong Kong with no presence in mainland China ([Fang, 2016](#)). The numbers are quite small given the potential size of the Chinese market. Some Chinese universities have used in-house learning platforms or the platforms developed by local EdTech companies to distribute learning materials, communicate with students, and collect assignments.

Prior to the COVID-19 pandemic, the use of the Internet for learning is found to be quite limited in Chinese universities (e.g., [Zhou, 2016](#)). [Ma \(2010\)](#) surveys academics in top universities in China and finds that about half of them have used internet-based technologies for blended learning and only 25% have used the technologies for distant education. Most lecturers in Chinese universities have a positive attitude to experiment and explore new educational technologies but face challenges that arise from lack of leadership and support in e-learning ([Ma, 2010](#)).⁶

[Huang et al. \(2019\)](#) conduct a large-scale study, covering 4,561 students from 16 universities in China, to study factors influencing the intention of Chinese university students to use Internet-based technology for learning. They find that perceived usefulness, perceived ease of use, and the subjective norm (i.e., peer influence, teacher influence, and institutional support) significantly affect Chinese students' attitude towards using the Internet-based technology for learning.⁷

[Van Raaij and Schepers \(2008\)](#) examine the acceptance and use of a virtual learning environment (VLE) in China. They find that perceived usefulness has a direct effect on VLE use, whereas perceived ease of use and subjective norm have only an indirect effect via perceived usefulness. Moreover, personal innovativeness and computer anxiety directly affect perceived ease of use.

⁴ As explained by [Crisp and Ward \(2008\)](#), a scenario question describes a realistic situation and asks students to diagnose causes, suggest possible solutions, and illustrate the theoretical basis to predict the effect of a proposed intervention.

⁵ China initially focused on network/infrastructure construction but more recently has focused on developing information technology platforms ([Jiao et al., 2014](#)). There has been a significant increase in the use of Internet-based technology in Chinese HEIs over the last decade since the issuance of the *Ten-year Development Plan for Education Digitalization (2011–2020)* by the Chinese government ([Ministry of Education of the People's Republic of China, 2012](#)).

⁶ When coronavirus outbreak shut down universities in China in February 2020, thousands of Chinese university students commenced learning online. Switch to online learning posed a serious challenge to universities that had not previously invested in virtual learning platform and to academics and students with little or no experience in online learning. Students had to get themselves familiar with the learning platform, which could be unstable due to poor connection and technical problems. Lecturers had to redesign their courses and learn online teaching techniques ([Han, 2020](#)).

⁷ The authors define "subjective norm" as "the degree to which an individual perceives that people who are important to him or her think he or she should (or should not) perform a behavior", which is the use of internet-based technology for learning in that context ([Huang et al., 2019](#)).

To sum up, prior studies suggest that English language ability and prior educational background affect the learning approach and performance of Chinese overseas students in Western HEIs. Online assessment may be an efficient and effective way to improve course engagement and academic performance of Chinese students but needs to be well designed and take into account student characteristics and learning and teaching context.

3. Research design

3.1. Background of the study

The study is conducted at a unique Sino-British collaborative institution, which is a result of the partnership between one of the red brick universities of England and a C9 League Chinese University. It is the only university in China to offer both UK and Chinese accredited degrees. All the degree programs are taught 100 percent in English, in line with the rigorous UK Quality Assurance Agency (QAA) standards. Students can choose to study at the UK partner university in Years three and four (2 + 2 route) or to complete the entire degree at the University in China (4 + 0 route). Therefore, the University offers a learning environment that closely resembles that of Western universities.

Examining Chinese students studying at the University in their home country allows us to isolate the effect of learning and assessment tasks on academic performance while controlling for other factors that could affect the performance of Chinese overseas students as identified by the prior literature, such as experiencing isolation and low self-esteem as a result of the difficulty to adapt to a new environment (Devlin and Peacock, 2009; Guo and Chase, 2011; Arshad and De Lima, 2012).⁸

Introduction to Financial Accounting and Accountability is a course offered to the second-year (equivalent to UK Year 1) undergraduate business students.⁹ It is a mandatory course in business cores. The course introduces accounting as the language of business and a tool for decision making. In this course, students learn how to prepare and analyze financial statements and appreciate the nature and concept of accountability and its relevance to corporate reporting. The textbook used for this course is written by professors at a UK university. A total of 488 students enrolled in this course in semester 1 of the 2018/19 academic year. Students are from a variety of business majors, including Information Management & Systems (IMS), Marketing (MKT), Business Administration (BAD), Economics (ECO), Human Resource Management (HRM), and English & Finance (ENF). A majority of them are Chinese local students.

The importance of the elementary accounting course in business schools has been well recognized by educators, professionals, and accounting organizations (e.g., the Accounting Education Change Commission, 1990, 1992 & 1996; Pincus, 1997; Vangermeersch, 1997; Ingram, 1998; the American Institute of Certified Public Accountants (AICPA), 2001). The Accounting Education Change Commission (1990, 1992 & 1996) emphasizes the importance of the first accounting course for all business majors. The course helps students develop accounting literacy (i.e., a general understanding of accounting and the ability to analyze and interpret accounting information), and thus are useful for non-accounting major students (e.g., Zukowsky, 1961; Ingram, 1998; Feast et al., 1999). The commission advocates that the course should help students develop analytical and conceptual skills and teach students to learn independently. Fostering a deep approach to learning is extremely important in implementing the commission's recommendations (e.g., Sharma, 1997).

Prior studies suggest that first-year undergraduate students have distinctive learning needs as they are experiencing academic and social transitions. The major challenge for these students is that they need to become self-managing and self-directed learners (e.g., Nelson et al., 2006). For Chinese local students, although they remain in their country of residence, they still need to take a transition to the Western-style all-English learning and teaching environment. Although students at the University had undertaken a number of courses to enhance their English language proficiency before progressing to the second year (equivalent to the first year at a British university), more than a third of the students report that learning the subjects in English is quite challenging for them. Further, students enrolled in this course are non-accounting majors who take the course to fulfill their business core. Since students tend to be less interested in the subjects that are outside their major field of study, it is important to stimulate student interest and to improve student engagement.

The course is taught by a series of thirteen weekly lectures of two-hour duration and twelve weekly tutorials of one-hour duration. To accommodate a large number of students enrolled, two lecture streams are offered and seven tutorial groups are organized. The learning activities are supported by the University's Interactive Communications Environment (ICE) virtual learning environment platform, which is used for providing students with lecture notes, videos, cases, practice questions, and supplementary readings. Lecture notes are available on ICE before the lecture for students to preview. Students are also expected to complete the prescribed readings prior to the lecture. Three sets of practice questions are provided to students each week, including (1) before-tutorial self-review questions, (2) tutorial questions, and (3) after-tutorial self-practice questions. Tutorial questions are discussed in the tutorial and students are expected to make good preparations. The other two sets of practice questions (i.e., before-tutorial self-review questions and after-tutorial self-practice questions), along with detailed solutions, are for students to complete by themselves. These questions do not count towards final grade.

⁸ Although it may be argued that these factors could still exist given the diverse student body at the University, they are of a less concern in this context due to the fact that Chinese students are studying in their home country which they are more familiar with.

⁹ The first year at the University is the foundation year, and thus the second year is equivalent to the first year at a British university.

In the previous academic year, course assessment comprised the mid-term exam (weighted 15%) and final exam (weighted 85%) with the effect that many students focused their attention on this course just before the exams. Attendance was poor and there was a lack of participation in tutorials. Performance suffered as a result and failure rate was high.¹⁰

Fig. 1 graphically summarizes the previous discussion. Students are expected to learn autonomously and actively. Assessment only took place in the middle and at the end of the semester and thus did not create a strong incentive for students to make consistent efforts. In addition, the assessment did not provide much ongoing feedback to students. A redesign of assessment may help improve student engagement and performance.

3.2. Description of the online review exercises

A change in course assessment is therefore proposed to improve student engagement and performance. We include two online review exercises (weighted 10% in total) in addition to the midterm and final exams, which are now weighted 15% and 75%, respectively. All the other learning tasks remain unchanged. The online review exercises are implemented via ICE. The first online review exercise is scheduled in week 6 (before the midterm exam) and the second in week 12 (after the midterm exam and before the final exam). Students can work on the exercises anytime, anywhere during the week of assessment. Both the review exercises are non-MCQs with each set of exercise having only one integrative question.

In the first online review exercise, students are provided with a number of typical transactions of a hypothetical company and are required to prepare the Balance Sheet using the accounting equation. The exercise intends to help students better understand the accounting equation that links resources with their sources and uses. Beginning with the accounting equation helps students comprehend the meaning of the transactions (e.g., Ingram, 1998).¹¹

In the second online review exercise, students are required to prepare the Balance Sheet, Income Statement, and Statement of Changes in Owners' Equity for a hypothetical company based on the information provided. The second online review exercise is more challenging because it has a variety of transactions covering a wider range of topics, including acquisition, depreciation, revaluation, and disposal of fixed assets, bonus issue, rights issue, payment of dividends, purchase and sale of merchandise inventory, prepayments, as well as accrued revenue and expense. Due to the cumulative nature of the exercises, the second online review exercise not only covers the new material but also reinforces the material previously learnt. Students are expected to demonstrate a good understanding of how transactions are connected to financial statements and the relationship among the statements.

Both the online review exercises have time constraints, with 1 h for the first exercise and 1.5 h for the second. Students would need to concentrate on the exercises in order to complete them within the time limit. Students can attempt the exercise as many times as they want during the week of assessment. Immediately after each attempt, students can see not only their scores but also the areas they lost their marks. However, they cannot see the solution until the closing date of each online review exercise. Students are free to view lecture notes, textbook, and other learning materials and to discuss with other students. The highest score is recorded as their final score.

The online review exercises are designed to accommodate student characteristics and the learning and teaching context. As discussed above, the students just started learning in the Western-style all-English environment and were still in the process of becoming self-directed learners. The online review exercises are therefore designed to engage students in learning, promote deep learning, provide feedback, and enhance students' motivation and self-confidence. More frequent assessment is expected to increase student engagement and to encourage them to make consistent efforts throughout the course. Further, the online review exercises require students to apply their knowledge to solve problem questions. Each exercise integrates multiple topic areas and students need to demonstrate mastery of knowledge. Students are provided with the opportunity to review learning materials and discuss with other students when working on the exercises. Thus, the online review exercises may help stimulate a deep approach to learning. Moreover, although the online review exercises are summative, they have a formative aspect. The exercises measure student learning and help students identify areas of improvement. Students are provided with timely feedback after each attempt to facilitate self-reflection and active engagement in their own learning.¹² In addition, the online review exercises aim to improve student motivation by recording the highest score as the final score. According to expectancy theory (Vroom, 1964; Porter and Lawler, 1968), an individual will be willing to work hard if he/she expects that his/her efforts will lead to better performance and that better performance will lead to valuable rewards. The exercises are likely to boost students' confidence, especially for those with weaker English language skills. Fig. 2 graphically summarizes the previous discussion by highlighting how the revised assessment design is aligned with student characteristics.

¹⁰ Students need to achieve an overall score of at least 40 in order to pass this course and an overall score of at least 70 to receive a Distinction.

¹¹ As an elementary accounting course for non-accounting students, the course does not intend to excessively focus on the mechanics of book keeping. Rather, the focus is on helping students develop the ability to analyze and interpret accounting information. Basic accounting processes are taught without reference to debits and credits in this course. Prior research suggests that debits and credits are not necessary in any computerized accounting system and that the accounting equation is the key to understand the accounting process (e.g., Ingram, 1998).

¹² In addition, after the closing date of each online review exercises, students are provided with detailed feedback on what the correct answer is and why. Moreover, students can make an appointment with the module leader to further discuss any questions related to the online review exercises.

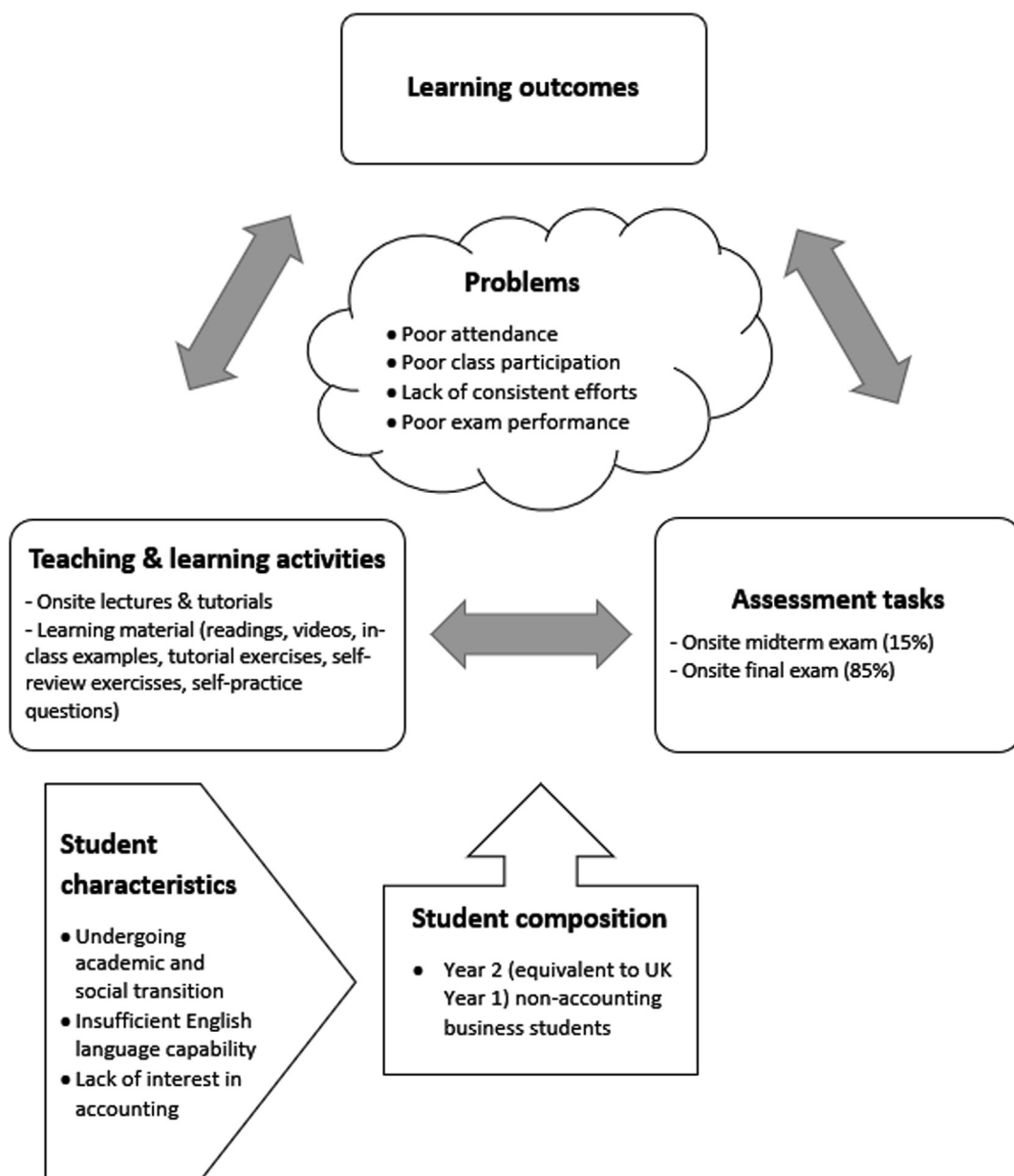


Fig. 1. Overview of the course design, student characteristics and the problems.

3.3. Methods

We survey students' perceptions about the online review exercises. We also perform regression analysis based on the data saved in ICE log files to examine the effect of online review exercises on student engagement and performance. Data collected from the survey supplement data obtained from the system log files, allowing a better understanding of student learning engagement and learning activities.

At the end of the semester, students enrolled in this course were invited to complete an anonymous online survey via ICE. The survey contained a total of 14 open and closed questions aimed to understand how students worked on the online review exercises and how they perceived these exercises. Questions 1, 6 and 7 measure the effect of online review exercises on student engagement. Question 1 asks students how much time they spent on preparing for the online review exercise before making their initial attempt. Questions 6 and 7 ask students how much time they spent on preparing for further attempt(s) after their initial attempt for review exercises 1 and 2, respectively. These questions help us understand the amount of effort students put into completing the online review exercises.

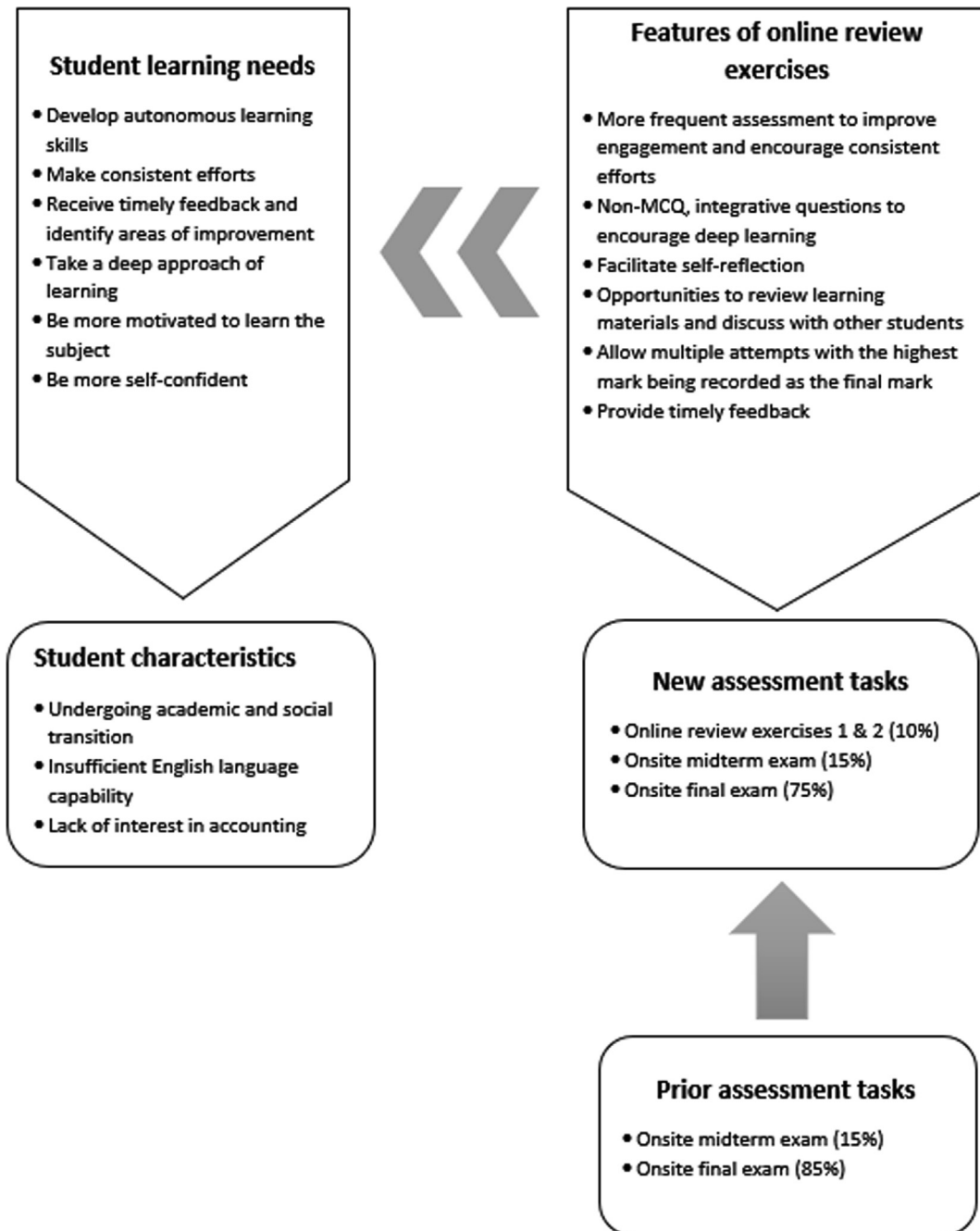


Fig. 2. The design of the online review exercises in alignment with student characteristics.

In addition, Questions 4 and 5 ask students what learning activities they undertook during the online review exercises and between attempts, respectively. Question 8 asks students about the learning activities that are helpful in improving their online review exercise scores. A number of learning activities are listed in the questions and students may mark all the applicable options. These questions help us understand how students learn and their preferred learning activities.

Questions 2 and 3 aim to understand students' perceptions of the difficulty levels of the online review exercises 1 and 2, respectively. Students answer the questions using a five-point Likert scale with the difficulty levels ranging from "very easy" to "very difficult". These questions are included because the difficulty levels of the questions could affect the amount of time students spent on preparing for these exercises.

Question 9, 10 and 11 ask students whether the online review exercises help them identify areas of improvement, improve their understanding in the subject, and enhance their motivation, respectively. These questions involve students marking “yes” or “no” answers to each statement and seek to measure the effect of the online review exercises on student learning performance and motivation.

Question 12 asks students whether they prefer online assessment to paper-based assessment. Finally, questions 13 and 14 are open questions, asking students about the features of the online review exercises they like or dislike. Students' feedback on these questions would be helpful for us to improve the design of the online review exercises in the future. The survey instrument is presented in Appendix A.

3.4. Models

We employ equation (1) (Appendix C) to examine how student engagement with the online review exercises impacts their performance. The dependent variable is the score of online review exercise 1 or 2 obtained by a student at each attempt. The variable of interest is the amount of time a student spent on completing the online review exercise at each attempt, a proxy for student engagement.¹³ This variable captures student effort and distinguishes between those who make a serious attempt and those who exert minimal efforts.¹⁴ A positive coefficient on this variable indicates that student engagement with the online review exercises has a positive effect on student performance in the exercises. Control variables include (1) indicator variables representing the second, third, fourth, fifth, and sixth (or a further) attempt by a student to capture variations in mean scores across attempts; (2) indicator variables representing different programs to capture variations in student performance across programs; (3) an indicator variable representing overseas students to see whether there are any differences between the performance of Chinese local students and that of overseas students/exchange students; and (4) an indicator variable representing male students.¹⁵ The detailed definitions of the variables are provided in Appendix B.

Equation (2) (Appendix C) is employed to examine the effect of online review exercise 1 on student performance in the midterm exam. In this equation, the dependent variable is the midterm exam score of a student. Our main variable of interest is the total number of times a student accessed online review exercise 1, which proxies for student effort in completing the first online review exercise.¹⁶ A positive coefficient on this variable indicates that online review exercise 1 has a positive effect on student performance in the midterm exam. We control for the level of student effort in the first half of the semester, as proxied by the total number of times a student accessed the learning materials on ICE during the first half of the semester, excluding online review exercise 1.¹⁷ We also control for attendance and preview of learning materials before lectures/tutorials in the first half of the semester, which are proxies for students' motivation.¹⁸ In addition, indicator variables are included to capture variation in student performance between overseas students and Chinese local students, between female and male students, and across different programs.

Finally, equation (3) (Appendix C) is employed to examine the effect of online review exercise 2 on student performance in the final exam. The dependent variable in this equation is the final exam score of a student. The variable of interest is the total number of times a student accessed online review exercise 2.¹⁹ A positive coefficient on this variable indicates that review exercise 2 has a positive effect on student performance in the final exam. We control for the level of student effort, attendance, and preview of learning materials throughout the semester. Indicator variables are included to capture variation in student performance between overseas students and Chinese local students, between female and male students, and across different programs. A detailed discussion of the regression models is provided in Appendix C.

4. Findings

4.1. Summary statistics

Panel A of Table 1 presents sample distribution by program. A total of 488 business students are enrolled in this course. Students from ECO program account for the largest percentage of the student cohort (54.10%), followed by students from IMS (13.11%) and students from BAD (12.91%). The students from all of these programs have similar entry scores and thus there is no systematic difference in the previous academic performance of these students. Female students (321) are significantly more than male students (176). Panel B categorizes the sample students into Chinese local students and overseas students. A majority (93.24%) of the students are Chinese local students. Overseas students are from various countries, including the UK, South Korea, Indonesia, among others.²⁰

¹³ The variable is log transformed. A detailed explanation is provided in Appendix C.

¹⁴ Because a time limit is set for both the online exercises (60 min for exercise 1 and 90 min for exercise 2), the total amount of time spent by a student on an exercise cannot exceed the time limit. However, there could be substantial variations within the time limit.

¹⁵ This variable is included in the model because prior studies have mixed findings regarding the gender effect on academic performance.

¹⁶ The variable is log transformed. A detailed explanation is provided in Appendix C.

¹⁷ The variable is log transformed. A detailed explanation is provided in Appendix C.

¹⁸ Students who are highly motivated to excel in the course tend to make good preparations for the class by previewing the learning materials. Similarly, students with a good attendance record tend to do well in the course (Wong, 2013).

¹⁹ The variable is log transformed. A detailed explanation is provided in Appendix C.

²⁰ The exchange student from the UK partner university undertaking the Year in China (YIC) program is included in overseas students in Panel B of Table 1.

Table 1
Sample composition.

Panel A: Student distribution by program				
	Male	Female	Subtotal	Percent
Business Administration (BAD)	28	35	63	12.91
Economics (ECO)	93	171	264	54.10
English & Finance (ENF)	0	6	6	1.23
Human Resource Management (HRM)	5	29	34	6.97
Information Management & Systems (IMS)	27	37	64	13.11
Marketing (MKT)	23	33	56	11.48
Year in China (YIC)	0	1	1	0.20
Total	176	312	488	100%
Panel B: Chinese local students vs Overseas students				
	Male	Female	Subtotal	Percent
Chinese local students	159	296	455	93.24
Overseas students	17	16	33	6.76
Total	176	312	488	100%

Panel A of [Table 2](#) presents the statistics on attendance. The results show that student lecture attendance rate is high at the beginning of the semester and gradually declines over the semester. Tutorial attendance rate exhibits a similar pattern. Panel B of [Table 2](#) shows the percentage of students who previewed course material on ICE at least one day before lectures/tutorials (i.e., preview rate). The lecture preview rate is generally low. This suggests that most of the students do not have a habit to preview course material and prefer to be led by the lecturer. The tutorial preview rate is higher, which is likely due to the fact that the module leader has emphasized the importance of attempting the tutorial questions in advance. In the first half of the semester, the tutorial preview rate peaks in week 6 (64.75%) when the online review exercise 1 was held and is also relatively high in week 5 (46.11%) and week 7 (before the midterm exam) (44.67%). In the second half term, the tutorial preview rate drops significantly. This might be either because students were busy with the coursework of other subjects, or because they became overconfident as they thought that they had been performing well in this course.

[Table 3](#) presents the total number of times the course material on ICE were accessed by the students each week (*Total access number*) from week 1 to week 15. The mean *Total access number* is 10,675.6 per week (equivalent to 21.88 per person per week). *Total access number* in week 6 (when the online review exercise 1 was held) is 31,648 (equivalent to 64.85 per person per week), which is nearly three times the average. Similarly, *Total access number* in week 12 (when the online review exercise 2 was held) is 34,724 (equivalent to 71.16 per person per week), which is more than 3 times the average. *Total access number* includes access to the online review exercises, and thus could be naturally high in the weeks when these exercises were held. We therefore further compute *Total access number_adj*, (i.e., *Total access number* minus the number of times students accessed the online review exercises). We find that *Total access number_adj* remains high in the week when each online review exercise was held and the week immediately before each online assessment. This indicates that students worked harder when the assessment was due.

[Table 4](#) presents statistics on student performance. Panel A of the table shows student performance by assessment component. Students performed well in both the online review exercises. The mean (median) score of the first online exercise is 90.11 (99) and the mean (median) score of the second online exercise is 86.04 (99.5). The scores of both the exercises are left-skewed. The standard deviation of the first online review exercise score is 24.55 and that of the second online review exercise score is higher (29.47). Students performed reasonably well in the midterm exam, achieving an average of 70.48. The mean score of the final exam is 48.11 with a standard deviation of 20.37.²¹

Panel B of [Table 4](#) reports the mean (median) score by attempt for online review exercise 1 and 2, respectively. For online review exercise 1, students made a total of 1,214 attempts. The number of attempts ranges from 1 to 20. A total of 465 students attempted the exercise at least once. 23 students did not complete the first exercise and thus scored 0. The mean (median) number of attempts for online review exercise 1 is 2.6 (2). For online review exercise 2, students made a total of 2030 attempts. The number of attempts ranges from 1 to 83. A total of 464 students attempted the exercise at least once. The mean (median) number of attempts for online review exercise 2 is 4.4 (3). For both review exercises, the mean score initially increases with the number of attempts and then declines. The mean scores of both the review exercises are the highest in the third attempt, suggesting that students' understanding of the subject has improved. The decline in the mean score in the attempts after the third one is likely to be due to the self-selection bias -- high performing students do not need to make many attempts to achieve a satisfactory score and only the students who performed poorly in earlier attempts would have to make more attempts. Therefore, the mean and median scores in later attempts mainly reflect the performance of these weaker students.

²¹ Both the midterm and final exams are paper-based and proctored, and students are not permitted to retake the exams.

Table 2
Attendance rate and the percentage of students who preview learning material.

Panel A: Attendance rate in lectures and tutorials																
	Week #1	Week #2	Week #3	Week #4	Week #5	Week #6	Week #7	Week #8	Week #9	Week #10	Week #11	Week #12	Week #13	Week #14	Week #15	
				Public holiday		Online review exercise 1		Midterm exam				Online review exercise 2				
Lectures	89.96%	83.81%	87.76%	/	79.30%	74.59%	68.44%	/	62.70%	65.16%	58.81%	58.20%	40.16%	42.01%	43.65%	
Tutorials	/	80.94%	65.37%	/	65.78%	61.48%	55.74%	/	54.71%	55.94%	47.54%	44.88%	31.15%	31.35%	/	
Panel B: The percentage of students who preview the learning material on ICE																
	Week #1	Week #2	Week #3	Week #4	Week #5	Week #6	Week #7	Week #8	Week #9	Week #10	Week #11	Week #12	Week #13	Week #14	Week #15	
				Public holiday		Online review exercise 1		Midterm exam				Online review exercise 2				
Lectures	6.56%	8.81%	14.75%	/	11.48%	22.75%	36.48%	/	19.88%	29.71%	33.40%	9.43%	13.32%	16.60%	17.01%	
Tutorials	/	53.28%	43.44%	/	46.11%	64.75%	44.67%	/	60.66%	36.07%	34.02%	35.25%	21.31%	21.52%	/	

This table provides statistics on attendance rate for lectures and tutorials, respectively (Panel A), and the percentage of students who preview the learning material on ICE at least one day prior to the lecture/tutorial (Panel B).

Table 3

Access to course material on ICE.

	Week #1	Week #2	Week #3	Week #4	Week #5	Week #6	Week #7	Week #8	Week #9	Week #10	Week #11	Week #12	Week #13	Week #14	Week #15	Average (per week)
				Public holiday		Online review exercise 1		Midterm exam				Online review exercise 2			Revision and Q&A	
<i>Total access number</i>	10,201	11,559	6866	2941	10,189	31,648	9183	12,856	5897	5798	6218	34,724	3906	4392	3756	10675.6
<i>Total access number_adj</i>	9760	10,774	6412	2941	9433	12,582	8442	12,658	5366	5239	5628	10,674	3445	3981	3483	7387.87
<i>Total access number_normal</i>	6046	7447	4921	1452	5335	6808	4566	7234	3441	3170	3572	5426	2198	2462	2068	4409.73
<i>Total access number_overtime</i>	3714	3327	1491	1489	4098	5774	3876	5424	1925	2069	2056	5248	1247	1519	1415	2978.13

This table reports the total number of times students accessed the learning materials on ICE each week by the students. *Total access number* includes the total number of times students accessed ICE homepage and course materials on ICE, whereas *Total access number_adj* excludes the access to the two online review exercises, as well as the attendance page and online survey. *Total access number_normal* refers to the total number of times course materials were accessed by students during the normal working hours (9:00am-5: 59 pm, Monday-Friday). *Total access number_overtime* refers to the total number of times course materials were accessed by students outside the normal working hours.

Table 4
Student performance.

Panel A: Student performance by assessment components						
	Min	Max	Mean	Median	S.D.	
Online review exercise 1	0	100	90.11	99	24.55	
Midterm exam	0	100	70.48	72	17.43	
Online review exercise 2	0	100	86.04	99.5	29.42	
Final exam	0	100	48.11	46	20.37	
Panel B: Student performance in each online review exercise						
Online review exercise 1	Attempt #1	Attempt #2	Attempt #3	Attempt #4	Attempt #5	Attempt #6 and more
No. of submissions	465	318	193	103	44	91
Median score	73.91	90.67	95.65	96.52	85	46.09
Mean score	64.81	74.95	79.05	76.45	66.28	50.27
Median length (minutes)	46.00	27.00	21.00	16.00	12.50	10.00
Mean length (minutes)	43.64	31.09	24.37	18.07	13.68	11.08
Online review exercise 2	Attempt #1	Attempt #2	Attempt #3	Attempt #4	Attempt #5	Attempt #6 and more
No. of submissions	464	354	255	171	121	665
Median score	23	55	80	76	77	2
Mean score	41.73	53.14	58.51	57.06	55.09	24.60
Median length (minutes)	54.00	23.00	14.50	12.00	10.00	2.00
Mean length (minutes)	52.37	35.85	27.02	20.73	14.89	13.26

This table provides statistics on student performance in the assessment tasks. Panel A presents student performance by assessment component. Panel B reports the mean (median) score by attempt for online review exercise 1 and 2, respectively.

4.2. Survey results

A total of 194 students completed the online survey, representing approximately 42% of the students who completed both the online review exercises.²² The number of hours students spent on preparing for each online review exercise before making their first attempt varies from 1 to 10, with a mean of 3.24 h. When making the first attempt, about 47% of the students find online review exercise 1 is not too easy and not too difficult, 28% of the students think it is easy, 16% of the students think it is very easy, 7% of the students think it is difficult, and 2% think it is very difficult. With respect to online review exercise 2, 32% of the students think it is very difficult, 29% think it is difficult, 22% of the students think it is not too easy and not too difficult and 17% of the students think it is easy or very easy (Fig. 3). Students perceive that the difficulty level of online review exercise 2 is higher than that of online review exercise 1. This is consistent with our intention because we want to help students build self-confidence by gradually increasing the difficulty level. Moreover, online review exercise 2 integrates a wider range of topics and is therefore more difficult.

Students undertook a variety of learning activities while attempting the online review exercises. 53% of the students report that they reviewed lecture notes. 22% report that they either worked together with other students or communicated with other students via social media (e.g., WeChat). 24% of the students report that they worked on the exercise by themselves.

After completing the first attempt and before making further attempts, all the students report that they looked at the feedback provided by the system (i.e., their scores and where they lost marks), 70% of the students reviewed the relevant sections in the textbook/lecture notes, 53% of the students reviewed tutorial questions and additional practice questions, 43% of the students discussed with other students by email or WeChat, 40% of students had face-to-face discussions with other students, 23% of the students copied, pasted, and saved the online review exercise to continue working offline, and 9% of the students posted their questions on the online discussion board.

Students' learning activities during the online review exercise and between attempts together suggest that online review exercises promote engagement with the content, self, and others. The feedback received by students after each attempt helps them identify problems and facilitates learning through self-reflection and collaboration. Students' responses also indicate that different students may prefer different learning activities, with some learning by themselves and others learning by collaboration, and that many students undertook more than one learning activities (e.g., review learning material, self-reflection and discussion with other students by email or WeChat).

²² Carley-Baxter et al. (2009) find that the response rate in education research is typically at 45%. They suggest that a lower response rate does not necessarily mean that a sample is skewed. For most studies, the people who did not participate are typically not different from those who participated (i.e., they usually have the same attitude and behavior). The most important thing about sampling is that the sample should be representative. The response rate of our study is close to the typical response rate in education research.

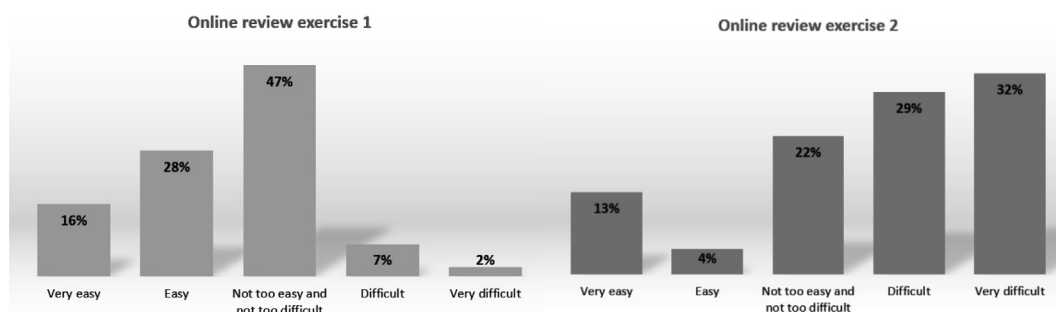


Fig. 3. Students' perceived difficulty levels of online review exercises 1 and 2.

The amount of time students spent on preparing for online review exercise 1 after completing their first attempt and before making further attempts varies substantially. About 49% of the students report that they spent 1 h preparing, 27% report 2 h, 11% report 3 h, and 13% report at least 4 h. For online review exercise 2, 39% of the students report that they spent at least 4 h making further preparation, 23% report 2 h, 20% report 3 h, and 18% report 1 h (Fig. 4). Students spent more time preparing for making further attempt(s) for online review exercise 2, consistent with online review exercise 2 having a higher difficulty level.

A majority of the students (60%) report that reviewing course materials (e.g., lecture notes, textbook, tutorial questions, and additional practice questions) is the most useful learning activity that helps improve their scores in later attempt(s). 30% of the students believe that discussion with other students is the most helpful. 10% of the students report that self-reflection and working on the exercise questions themselves greatly enhanced their performance in later attempt(s).

Nearly all the students (97%) agree that the online review exercises help them identify areas they need to improve on. 84% of the students believe their understanding of the subject has improved as a result of completing the online review exercises. 96% of the students agree that the online review exercises motivate them to make efforts to improve their learning performance. 85% of the students report that they prefer online assessment to paper-based assessment.

The features of the online review exercises that students report they like include: (1) multiple attempts are allowed with the highest score being recorded as the final score, (2) immediate feedback is provided after each attempt, (3) reviewing learning materials and discussing with other students are allowed, and (4) convenience of the assessment.

Representative comments by the students include:

- “Online review exercises are good. We can try many times, look up notes and discuss online. The exercises help me deepen my understanding.”

This comment indicates that the student likes the feature that the online review exercises allow multiple attempts and believes that his/her understanding of the subject is improved as a result of reviewing learning materials and discussing with other students.

- “First, if I didn't do well in my first attempt, I could have another try. It makes me less stressed. It also motivates me to correct my errors in later attempt because I want to get a higher score. Second, after submitting my answer, I can immediately know my deduction points. It provides useful hints. The correct answer is not immediately provided so that I need to keep thinking/analyzing until I find the correct answer. I think this process is really good for it helps me make progress.”

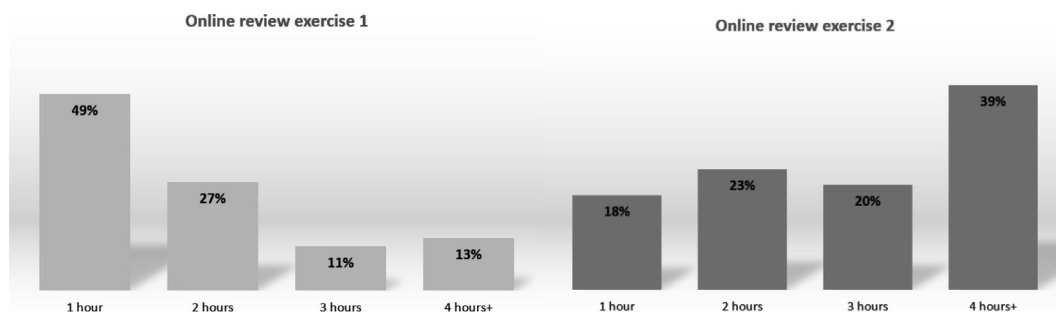


Fig. 4. Number of hours students spent on preparing for making further attempt(s) for online review exercises 1 and 2.

The student likes the feature of multiple attempts and thinks that being able to try many times makes him/her less stressed. He/she also points out the motivational effect of the online review exercise, that is the opportunity to get a higher score in later attempt motives him/her to keep studying. Moreover, he/she believes the hints he/she got immediately after each attempt are helpful. He/she further suggests that being able to immediately see where he/she lost marks but not the solution encourages him/her to keep thinking and this process really helps him/her improve his/her understanding of the subject.

- *"My roommate and I attend the same class and we do online review exercises together. After finishing the exercise, we discuss where we did wrong together. I'm glad that I can learn with my friend, and I do have a deeper understanding of this course after completing the exercises with my friend :)"*

This comment suggests that the student thinks that working with his/her friend on the online review exercises helps him/her develop a better understanding of the subject.

- *"The exercises are convenient. I can do the exercises whenever, wherever I like."*

This comment shows that the student believes that online review exercises are convenient because they can work on the exercises anywhere, anytime during the assessment week.

- *"It's really useful and easy to use."*

This comment suggests that the student finds that the online review exercises are useful and the online assessment is easy to use. Perceived usefulness and ease of use are the two important factors that affect students' acceptance and use of virtual learning environment in China (Van Raaij and Schepers, 2008; Huang et al., 2019). The student's comment indicates that he/she has a positive view of the online review exercises.

The features of the online review exercises that students report they dislike mainly concentrate on (1) the webpage layout and (2) the complexity/difficulty of the questions.

Representative comments by the students include:

- *"I hope that the online review exercises can be moderate in difficulty and easier to read."*

The comment suggests that the student believes that the difficulty level of the online review exercises is a bit high for him/her. His/her English language ability may have affected his/her comprehension of the question.

- *"It'd be better if the question and answer area are on the same page so that I don't have to switch between the pages."*

This comment shows that the student thinks that the page layout of the online review exercises could be more user-friendly by having the question and answer area on the same page.

- *"I prefer MCQs."*

The reason that the student prefers MCQs may be that he/she perceives that MCQs are generally easier. It reflects that the online review exercises in the form of integrative, non-MCQ questions require a thorough understanding of the subject and higher cognitive skills and students need to make real efforts in order to do well.

- *"First, my screen is small and the question is long. It's visually uncomfortable and I have to scroll up and down. Second, the system does not allow taking notes online or highlighting on the question. This is troublesome."*

This comment is related to webpage layout of the exercises. Viewing a long question on computer screen makes the student uncomfortable. He/she is also concerned with the lack of certain features within the system and wishes it would be possible to take notes and highlight important points in the webpage.

- *"The time tracker is really annoying. When there were five minutes left, it appeared and blocked my view of the question."*

This student suggests the time tracker be moved to another place on the web page so that it would not affect him/her viewing the question.

4.3. Regression results

4.3.1. Student effort and student performance in the online review exercises

We examine the relation between the level of student effort in completing the online review exercises and student performance in these exercises. Table 5 presents coefficient estimates for equation (1). As shown in columns (1) and (2), *Log (Length)* is positively related to *E1Score*, suggesting that students who made a serious effort in completing online review

Table 5
Student effort and student performance in online review exercises.

	<i>E1Score</i>	<i>E1Score</i>	<i>E2Score</i>	<i>E2Score</i>
	(1)	(2)	(3)	(4)
<i>BAD</i>	-10.169*** (0.005)	-9.452*** (0.009)	-6.269 (0.174)	-7.597 (0.181)
<i>ENF</i>	-8.599* (0.091)	-12.142** (0.029)	-22.009*** (0.000)	-13.498 (0.135)
<i>HRM</i>	-8.476* (0.073)	-5.641 (0.102)	9.878* (0.060)	8.069* (0.061)
<i>IMS</i>	2.486 (0.559)	2.373 (0.544)	-3.837 (0.509)	-0.460 (0.933)
<i>MKT</i>	-1.084 (0.835)	1.095 (0.793)	6.132 (0.190)	8.176* (0.051)
<i>YIC</i>	-27.383*** (0.000)	-29.738*** (0.000)	-33.868*** (0.000)	-44.404*** (0.000)
<i>Male</i>	-2.215 (0.427)	-0.218 (0.931)	-4.139 (0.225)	-1.828 (0.589)
<i>OVR5</i>	-1.600 (0.792)	-1.574 (0.760)	-17.518*** (0.000)	-17.013*** (0.003)
<i>Log(Length)</i>	37.128*** (0.000)	26.940*** (0.000)	14.400*** (0.000)	9.164* (0.051)
<i>AT2</i>	16.497*** (0.000)	12.290*** (0.000)	14.798*** (0.000)	5.771** (0.035)
<i>AT3</i>	25.374*** (0.000)	17.841*** (0.000)	22.560*** (0.000)	12.183*** (0.000)
<i>AT4</i>	29.127*** (0.000)	20.659*** (0.000)	22.777*** (0.000)	13.506*** (0.000)
<i>AT5</i>	26.604*** (0.000)	14.998*** (0.005)	23.263*** (0.000)	13.660*** (0.002)
<i>AT6</i>	14.772** (0.029)	9.988 (0.160)	1.470 (0.723)	-8.300* (0.058)
Constant	7.897 (0.379)	29.408** (0.022)	21.537*** (0.002)	45.758*** (0.000)
Number of observations	1214(full sample)	1124(score ≠ 0)	2023(full sample)	1493(score ≠ 0)
R Square	0.1748	0.1128	0.1672	0.1229

This table presents coefficient estimates for equation (1). The *p*-values are in the parentheses. The standard errors are clustered at the student level. *E1Score* (or *E2Score*) is the response variable. Explanatory variables include *BAD*, *ENF*, *HRM*, *IMS*, *MKT*, *YIC*, *Male*, *OVR5*, *Log(Length)*, *AT2*, *AT3*, *AT4*, *AT5*, and *AT6*. The variables are defined in Appendix B. *, **, *** denote the significance levels at 10%, 5%, and 1%, respectively.

exercise 1 achieved a higher score in that exercise.²³ Further, the coefficients on the indicator variables representing later attempts up to the 5th one are all positive and significant, indicating that the mean scores of these later attempts are higher than the mean score of the first attempt.

The estimation results of the regression with *E2Score* as the response variable are shown in columns (3) and (4).²⁴ *Log(Length)* is positively related to *E2Score*.²⁵ The coefficient on indicator variables representing later attempts up to the 5th one are all positive and significant.

Overall, the results suggest that the level of student effort in completing the online review exercises are positively related to their performance in these exercises. Moreover, the mean scores in later attempts (up to the 5th one) are higher than the mean score of the first attempt, consistent with online review exercises helping students improve their understanding of the subject.

4.3.2. The effect of online review exercises on student performance in the midterm exam

Panel A of Table 6 presents the estimation results for equation (2). Because two students did not attend the midterm exam, our sample size was reduced to 486. As shown in Column (1), the mean midterm exam scores of the students from *BAD*, *ENF*, *HRM*, *IMS*, and *MKT* are not significantly different from the mean score of the students from *ECO*. The student from *YIC* performed worse than students from *ECO*. Male students underperformed relative to female students.

In column (2), the coefficients on the variables representing attendance rate in the first half of the semester (*ATTD01*), preview rate in the first half of the semester (*PREV01*), and the interaction term of the two variables are all positive and sig-

²³ The estimation results as shown in column (2) are based on the sample excluding the students who scored zero in that attempt. The observations with a score of zero may not contain much useful information for our analysis because the students who scored zero in that attempt might just want to had a quick view of the exercise without the intention of completing it in that attempt. The time spent by such a student in that attempt was quite short as well, as indicated by the system log files.

²⁴ The results in column (4) are based on the sample that excludes students who scored zero.

²⁵ As indicated in column (4), a one percent increase in the mean length of time students spent on doing online review exercise 2 at each attempt results in an increase in the mean score by 0.09.

Table 6

Online review exercises and student performance in midterm and final exams.

Panel A	MidScore	MidScore	MidScore	MidScore
	(1)	(2)	(3)	(4)
BAD	-3.676 (0.147)	-1.476 (0.538)	-1.804 (0.445)	-1.705 (0.478)
ENF	-7.565 (0.441)	-8.942 (0.325)	-10.243 (0.254)	-10.128 (0.251)
HRM	-1.772 (0.580)	0.908 (0.769)	-0.227 (0.939)	0.536 (0.845)
IMS	2.930 (0.181)	4.029** (0.035)	4.170** (0.026)	3.690** (0.042)
MKT	-3.162 (0.273)	-3.116 (0.172)	-3.199 (0.156)	-2.786 (0.207)
YIC	-15.069*** (0.000)	-16.911*** (0.000)	-20.076*** (0.000)	-17.169*** (0.000)
Male	-6.135*** (0.000)	-1.427 (0.311)	-1.792 (0.199)	-0.751 (0.602)
OVR5	1.505 (0.666)	1.026 (0.758)	1.193 (0.725)	0.591 (0.861)
ATTD01		22.586*** (0.000)	18.210*** (0.000)	13.968*** (0.000)
PREV01		15.823*** (0.000)	14.451*** (0.000)	8.855** (0.013)
ATTD01*PREV01		26.789** (0.040)	34.114*** (0.007)	41.879*** (0.001)
Log(TNAE1)			8.051*** (0.000)	5.772*** (0.001)
Log(TNA01)				14.454*** (0.000)
Constant	73.565*** (0.000)	48.775*** (0.000)	40.822*** (0.000)	17.997*** (0.000)
Number of observations	486	486	486	486
R Square	0.0444	0.2475	0.2776	0.2996
Panel B	FinalScore	FinalScore	FinalScore	FinalScore
	(1)	(2)	(3)	(4)
BAD	-3.547 (0.240)	-0.700 (0.798)	1.809 (0.449)	1.660 (0.486)
ENF	2.361 (0.746)	0.061 (0.991)	3.023 (0.513)	2.599 (0.568)
HRM	-5.454 (0.104)	-2.931 (0.348)	-1.505 (0.617)	-1.335 (0.643)
IMS	2.226 (0.462)	3.834 (0.118)	5.933** (0.012)	5.682** (0.016)
MKT	-1.509 (0.654)	-1.682 (0.513)	2.248 (0.382)	2.232 (0.384)
YIC	-9.444** (0.038)	-14.287*** (0.001)	-8.348** (0.045)	-7.018 (0.106)
Male	-5.558*** (0.003)	0.178 (0.912)	0.708 (0.655)	1.157 (0.470)
OVR5	-0.695 (0.869)	-1.351 (0.731)	-4.689 (0.255)	-4.948 (0.209)
ATTD01		24.018*** (0.000)		
PREV01		21.872*** (0.000)		
ATTD01*PREV01		50.531*** (0.001)		
Log(TNAE1)		6.287*** (0.001)		
ATTD02			11.169*** (0.002)	8.398** (0.027)
PREV02			16.905*** (0.000)	11.756** (0.022)
ATTD02*PREV02			27.463** (0.050)	35.965** (0.013)
Log(TNAE2)			15.613*** (0.000)	14.517*** (0.000)

(continued on next page)

Table 6 (continued)

Panel B	FinalScore	FinalScore	FinalScore	FinalScore
<i>Log(TNA02)</i>				8.823** (0.034)
Constant	51.139*** (0.000)	13.125*** (0.000)	11.746*** (0.000)	−3.946 (0.617)
Number of observations	485	485	485	485
R Square	0.0275	0.2812	0.3710	0.3762

Panel A of this table presents coefficient estimates for equation (1). The associated *p*-value (in the parentheses) is calculated using heteroskedasticity robust standard errors. *MidScore* is the response variable. Explanatory variables include *BAD*, *ENF*, *HRM*, *IMS*, *MKT*, *YIC*, *Male*, *OVRS*, *ATTD01*, *PREV01*, *ATTD01*PREV01*, *Log(TNAE1)*, and *Log(TNA01)*. The variables are defined in Appendix B. *, **, *** denote the significance levels at 10%, 5%, and 1%, respectively.

Panel B of this table presents coefficient estimates for equation (2). The associated *p*-value (in the parentheses) is calculated using heteroskedasticity robust standard errors. *FinalScore* is the response variable. Explanatory variables include *BAD*, *ENF*, *HRM*, *IMS*, *MKT*, *YIC*, *Male*, *OVRS*, *ATTD01*, *PREV01*, *ATTD01*PREV01*, *Log(TNAE1)*, *ATTD02*, *PREV02*, *ATTD02*PREV02*, *Log(TNAE1)*, and *Log(TNA02)*. The variables are defined in Appendix B. *, **, *** denote the significance levels at 10%, 5%, and 1%, respectively.

nificant, suggesting that students with a higher level of motivation performed better in the midterm exam. In column (3), we further include *Log(TNAE1)* (i.e., the logarithm of the total number of times a student accessed online review exercise 1). This variable is positively related to midterm score. A one percent increase in the total number of times a student accessed online review exercise 1 results in an increase in the mean midterm score by 0.08. In column (4), we further control for *Log(TNA01)* (i.e., the logarithm of the total number of times a student accessed the learning material on ICE, excluding online review exercise 1, in the first half of the semester). The coefficient on this variable is positive and significant, suggesting that the mean midterm exam score increases with the total number of times a student accessed course materials (excluding online review exercise 1) in the first half of the semester.

Overall, the results suggest that student engagement with online review exercise 1 and other course materials on ICE have a positive effect on their performance in the midterm exam. In addition, a higher level of motivation and effort is associated with better performance in the midterm exam. We also note that, after controlling for student motivation and engagement, the mean midterm exam score of male students does not differ significantly from the mean score of female students. Further, the mean midterm exam score of students from *IMS* is significantly higher than the mean score of students from *ECO* after controlling for the level of motivation and engagement, suggesting that online review exercises may be more effective for students with better computer skills and a preference for online assessment.

4.3.3. The effect of online review exercise 2 on student performance in the final exam

Panel B of Table 6 presents the estimation results of equation (3). Three students who did not attend the final exam are excluded from the sample. Column (2) shows that the average final exam scores of students from *BAD*, *ENF*, *HRM*, *IMS*, and *MKT* programs are not significantly different from the average score of students from *ECO*. The student from *YIC* program underperformed relative to other students in the cohort. *Log(TNAE1)* is positively related to the mean final exam score, suggesting that online review exercise 1 has a positive effect on student performance in the final exam.

Column (3) shows that the coefficient on *ATTD02*PREV02* (i.e., the interaction term of attendance rate and preview rate over the semester) is positive and significant, suggesting that students who have both a good attendance record and often preview course materials during the semester performed better in the final exam. *Log(TNAE2)* (i.e., the logarithm of the total number of times a student accessed online review exercise 2) is positively related to the final exam score, suggesting that students with a higher level of engagement with online review exercise 2 performed better in the final exam. A one percent increase in the number of times students accessed online review exercise 2 results in an increase in the final exam score by 0.16. In column (4), *Log(TNA02)* (i.e., the logarithm of the total number of times a student accessed the learning materials on ICE, excluding online review exercises, over the semester) is included as a control variable. The coefficient on this variable is positive and significant, suggesting that student engagement with other course materials over the semester has a positive impact on their performance in the final exam.

Overall, the results confirm that online review exercises 1 and 2, as well as other course materials, have a positive impact on student performance in the final exam. In addition, *IMS* students outperformed *ECO* students in the final exam. The gender effect on final exam score is not significant after controlling for student motivation and efforts.

5. Conclusion

Chinese students undergoing a transition to the Western learning environment often experience difficulties due to their English language ability, prior education experiences, and cultural background. These students also exhibit a lack of autonomous learning skills. These factors could negatively impact their learning performance (e.g., Gow et al., 1991; Gieve and Clark, 2005; Wang and Moore, 2014).

We design online review exercises and examine their effect on the engagement and performance of a group of business students studying introductory financial accounting at an international joint venture university based in China. The results show that the students perceive the online review exercises to be useful. A majority of students agree that the online review exercises provide timely feedback that help them identify improvement areas. A majority of the students say that their understanding of the subject has improved as a result of completing the online review exercises. The results show that the level of student effort in completing the online review exercises is positively related to their performance in these exercises, midterm exam and final exam.

Students report that they undertook a variety of learning activities when working on the online review exercises, including reviewing course material, discussing with other students (face-to-face and/or online), and self-reflection. The most effective learning activities perceived by the students differ. Some students find that reviewing the course materials is the most effective way for them to improve their performance, while others say that they learn better when working together with other students.

The amount of time students spent on preparing for the online review exercises vary substantially from 1 to 10 h. Students also spent a substantial amount of time preparing for the online review exercises between each attempt, especially for online review exercise 2. Overall, the results suggest that most students have made a significant effort in completing the online review exercises.

We also examine student engagement in this course by analyzing attendance rate and the number of times the students accessed the course materials. We find that the number of times the students accessed the course materials peaks in the week of assessment and the week immediately before the assessment. The attendance rate was high at the beginning of the semester and gradually declined over the semester. In addition, many students do not seem to have a habit to preview course materials before lectures/tutorials, indicating a lack of intention to learn actively. The results suggest that although the online review exercises seem to increase student engagement with these exercises, the pre-class preparation and class participation have not yet increased evidently. Thus, further changes to learning and assessment activities may be needed. For example, weekly online assessment before class may be designed to encourage class preparation and active learning. In-class (individual or group) assessment may also be useful to improve attendance and class participation. Nonetheless, the online review exercises seem to be an effective and efficient learning tool in enhancing the learning engagement and performance of Chinese business students with no prior educational experience in Western universities and may be used to supplement other learning activities.

The study contributes to the accounting literature by providing evidence on how online assessment improves the learning performance of Chinese business students who are undergoing a transition to the Western learning environment. The study suggests that online summative assessment with a formative aspect is well perceived by these students and appear to have a positive effect on their learning performance. Students report that they feel that this type of assessment makes them feel less stressed and that the opportunity to review learning materials, self-reflect and discuss with other students while completing the assessment greatly helps them improve their understanding of the course content. They also state that this type of assessment enhances their study motivation.

Further, the students being examined in this study are non-accounting majors. These students may be less interested in the subject because it is outside their major field of study. The online review exercises could be used in combination with other learning and assessment activities to enhance motivation and engagement of such students. The results are informative to accounting academics who teach such students as investigated in this study.

Although the study was conducted before the COVID-19 pandemic, the results of the study are informative to accounting academics in the post-COVID-19 era as online education becomes a strategic priority at every HEI and blended learning is also expected to surge. The results of this study are useful for accounting academics at Western HEIs who are interested in designing effective online learning and assessment activities to improve the performance of Chinese overseas students with no prior educational experience in Western HEIs. This study is also relevant to accounting academics in traditional Chinese business schools, many of which have limited experience in online teaching and assessment pre-COVID-19 and are undertaking benchmarking exercises to improve their curricula and approaches to learning and teaching.

The study has three limitations. First, due to the way in which teaching is arranged at the University, it is not possible to have a control group that receives no treatment. While the online review exercises are found to have a positive impact on student learning performance, we cannot conclude a causal relationship (i.e., the online review exercises cause an improvement in learning performance). Second, the study examines the effect of only one type of online assessment (i.e., online review exercises). Future studies could compare this type of online assessment with other types (e.g., summative only, formative only, MCQs vs non-MCQs) and examine how different online assessment types impact student engagement and performance. Third, the study uses a combination of survey and regression analysis to investigate the effect of the online review exercises. Other qualitative methods such as interviews or focus groups could allow a better understanding of how the students use these exercises.

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Appendix A. Survey questionnaire

1. How many hours on average did you spend on preparing for the online review exercises before making your first attempt?
2. When making your first attempt, how did you find online review exercise 1?
 - ☐ Very easy
 - ☐ Easy
 - ☐ OK
 - ☐ Difficult
 - ☐ Very difficult
3. When making your first attempt, how did you find online review exercise 2?
 - ☐ Very easy
 - ☐ Easy
 - ☐ OK
 - ☐ Difficult
 - ☐ Very difficult
4. What learning activities did you undertake during each attempt of the online review exercises. (Select all the applicable options.)
 - ☐ Look at notes
 - ☐ Work together with other students
 - ☐ Communicate with other students via social media (e.g., WeChat)
 - ☐ Work on the exercise by myself
5. After your first attempt, what learning activities did you undertake before making further attempts? (Select all the applicable options.)
 - ☐ Look at my score and questions I answered incorrectly as indicated by the system
 - ☐ Read relevant sections in the textbook/lecture notes
 - ☐ Look for relevant tutorial questions/practice questions
 - ☐ Copy, paste, and save the online review exercises to continue working offline
 - ☐ Discuss with other students face-to-face
 - ☐ Discuss with other students by email or WeChat
 - ☐ Discuss with other students by posting a question on the online discussion board
6. How many hours did you spend on preparing for online review exercise 1 after your first attempt and before making further attempt(s)?
7. How many hours did you spend on preparing for online review exercise 2 after your first attempt and before making further attempt(s)?
8. What learning activities helped you score higher in later attempt(s)? (Select all the applicable options.)
 - ☐ Review lecture notes/textbook/tutorial questions/practice questions
 - ☐ Discuss with other students
 - ☐ Work on the online review exercise by myself
9. The online review exercises help me identify areas that I need to improve on. Do you agree or disagree?
 - ☐ Agree
 - ☐ Disagree

10. My understanding of the subject has improved as a result of completing the online review exercises. Do you agree or disagree?

- ☐ Agree
- ☐ Disagree

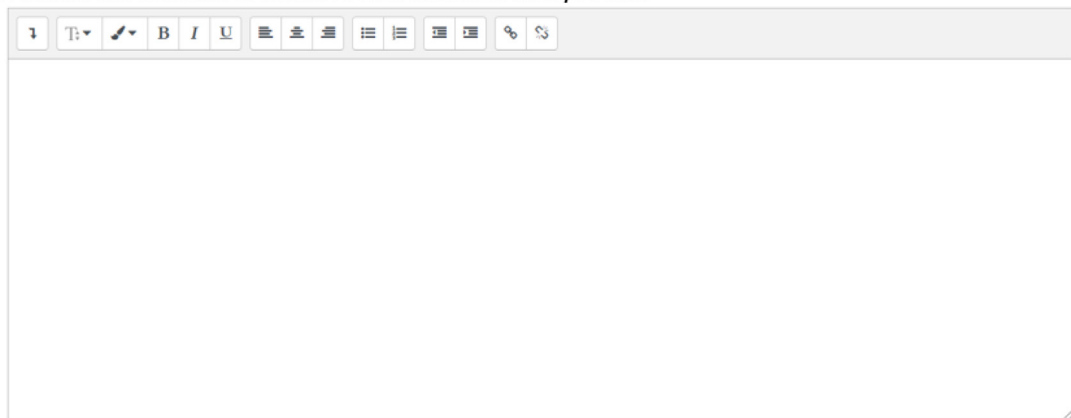
11. I am allowed to attempt each online review exercise multiple times and the highest score is recorded as the final score. This motivates me to make efforts to improve my performance. Do you agree or disagree?

- ☐ Agree
- ☐ Disagree

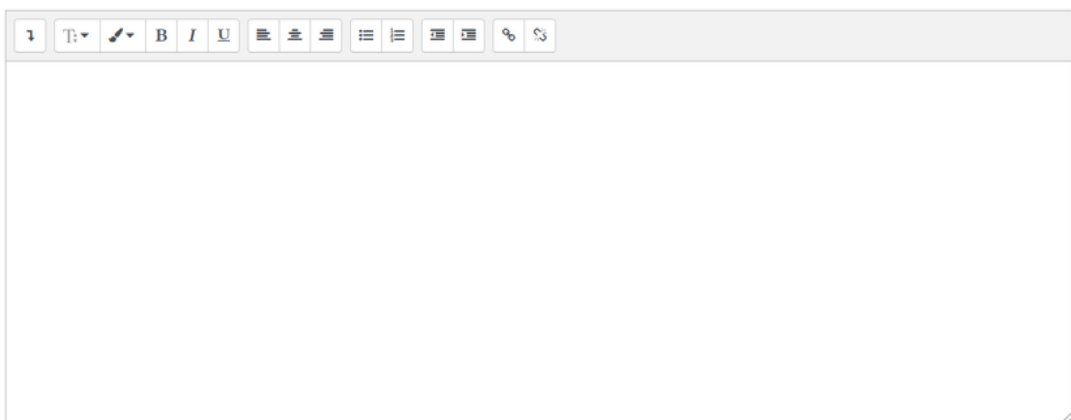
12. Do you prefer online assessment or paper-based assessment?

- ☐ Online assessment
- ☐ Paper-based assessment

13. Describe the features of online review exercises that you like.



14. Describe the features of online review exercises that you dislike.



Appendix B. . Variable definition

Variable	Definition
<i>MidScore</i>	The midterm exam score of a student.
<i>BAD</i>	An indicator variable that equals 1 if a student is from the program of Business Administration, and 0 otherwise.
<i>ENF</i>	An indicator variable that equals 1 if a student is from the program of English & Finance, and 0 otherwise.
<i>HRM</i>	An indicator variable that equals 1 if a student is from the program of Human Resource Management, and 0 otherwise.
<i>IMS</i>	An indicator variable that equals 1 if a student is from the program of Information Management & Systems, and 0 otherwise.
<i>MKT</i>	An indicator variable that equals 1 if a student is from the program of Marketing, and 0 otherwise.
<i>YIC</i>	An indicator variable that equals 1 if a student is on the exchange program (Year in China program from the UK partner university), and 0 otherwise.
<i>Male</i>	An indicator variable that equals 1 if a student is male, and 0 otherwise.
<i>OVRS</i>	an indicator variable that equals 1 if a student is an overseas student, and 0 otherwise.
<i>ATTD01</i>	The attendance rate of a student in the first half of the semester, calculated as the number of lectures and tutorials attended by the student divided by the total number of the lectures and tutorials between week 1 and week 7. The variable is mean-centered.
<i>PREV01</i>	The preview rate of a student in the first half term, calculated as the number of times the student previewed the learning material at least one day before the lecture or the tutorial divided by the total number of lectures and tutorials between week 1 and week 7. The variable is mean-centered.
<i>Log</i> The	(<i>TNAE1</i>) logarithm of the total number of times a student accessed the first online review exercise in week 6 when the exercise was held.
<i>Log</i> The	(<i>TNA01</i>) logarithm of the total number of times a student accessed the learning material on ICE between week 1 and week 7, excluding access to the review exercise and attendance page.
<i>FinalScore</i>	The final exam score of a student.
<i>ATTD02</i>	the attendance rate of a student throughout the semester, calculated as the number of lectures and tutorials attended by the student divided by the total number of lectures and tutorials between week 1 and week 15. The variable is mean-centered.
<i>PREV02</i>	The preview rate of a student throughout the semester, calculated as the number of times a student previewed the learning material at least one day before the lecture or the tutorial divided by the total number of lectures and tutorials between week 1 and week 15. The variable is mean-centered.
<i>Log</i> The	(<i>TNAE2</i>) logarithm of the total number of times a student accessed the second online review exercise in week 12 when the exercise was held.
<i>Log</i> The	(<i>TNA02</i>) logarithm of the total number of times a student accessed the learning material on ICE between week 1 and week 15, excluding access to the online review exercises, attendance page, and online survey.
<i>E1Score</i>	The score of the first online review exercise obtained at each attempt by a student.
<i>E2Score</i>	The score of the second online review exercise obtained at each attempt by a student.
<i>Log</i> The	(<i>Length</i>) logarithm of the number of minutes a student spent on completing the online exercise at each attempt.
<i>AT2</i>	An indicator variable that equals 1 if it is the second attempt by a student, and 0 otherwise.
<i>AT3</i>	An indicator variable that equals 1 if it is the third attempt by a student, and 0 otherwise.
<i>AT4</i>	An indicator variable that equals 1 if it is the fourth attempt by a student, and 0 otherwise.
<i>AT5</i>	An indicator variable that equals 1 if it is the fifth attempt by a student, and 0 otherwise.
<i>AT6</i>	An indicator variable that equals 1 if it is the sixth or a further attempt by a student, and 0 otherwise.

Appendix C. . Regression models

We are interested in understanding how student engagement with the online review exercises impacts their performance. The regression model is stated below:

$$E1ScoreorE2Score = \alpha + \beta_1 BAD + \beta_2 ENF + \beta_3 HRM + \beta_4 IMS + \beta_5 MKT + \beta_6 YIC + \beta_7 Male + \beta_8 OVRS + \beta_9 \log(Length) + \beta_{10} AT2 + \beta_{11} AT3 + \beta_{12} AT4 + \beta_{13} AT5 + \beta_{14} AT6 + \varepsilon \quad (1)$$

where the response variable is either *E1Score* or *E2Score*. *E1Score* is the score of the first online review exercise obtained by a student at each attempt. *E2Score* is the score of the second online review exercise obtained by a student at each attempt. $\text{Log}(\text{Length})$ is the logarithm of the number of minutes a student spent on completing the online review exercise at each attempt. Because a time limit is set for both the online exercises (60 min for exercise 1 and 90 min for exercise 2), the total length of time spent by a student on an exercise cannot exceed the time limit. However, there could be substantial variations within the time limit. Thus, the variable captures student effort and distinguishes between those who make a serious attempt and those who exert minimal efforts.

To examine variations in mean scores across attempts, we include *AT2*, *AT3*, *AT4*, *AT5*, and *AT6*, which are indicator variables representing the second, third, fourth, fifth, and sixth (or a further) attempt by a student, respectively. We include all the program indicators (*BAD*, *ENF*, *HRM*, *IMS*, *MKT*, *YIC*), except *ECO*, to capture the variations in the performance of students from different programs. *ECO* is excluded because students from Economics are used as the benchmark group. We include the indicator variables *OVRS/YIC* to see whether there are any differences between the performance of Chinese local students and that of overseas students/exchange students. Prior studies have mixed findings regarding the gender effect on academic performance, and thus we include the indicator variable *Male* as a control variable. The detailed definitions of the variables are provided in Appendix B.

We then examine the effect of online review exercise 1 on student performance in the midterm exam.

$$\begin{aligned} \text{MidScore} = & \alpha + \beta_1 \text{BAD} + \beta_2 \text{ENF} + \beta_3 \text{HRM} + \beta_4 \text{IMS} + \beta_5 \text{MKT} + \beta_6 \text{YIC} + \beta_7 \text{Male} + \beta_8 \text{OVRS} + \beta_9 \text{ATTD01} \\ & + \beta_{10} \text{PREV01} + \beta_{11} \text{ATTD01} * \text{PREV01} + \beta_{12} \text{Log}(\text{TNAE1}) + \beta_{13} \text{Log}(\text{TNA01}) + \varepsilon \end{aligned} \quad (2)$$

where *MidScore* is the response variable, which represents the midterm exam score of a student.

Our main variable of interest is $\text{Log}(\text{TNAE1})$ (i.e., the logarithm of the total number of times a student accessed the first online review exercise in week 6 when the exercise was held), which proxies for student effort in completing the first online review exercise. A positive coefficient on this variable indicates that the online review exercise has a positive effect on student performance in the midterm exam. We control for the level of student effort in the first half of the semester ($\text{Log}(\text{TNA01})$) (i.e., the logarithm of the total number of times a student accessed the learning material on ICE during the first half of the semester, excluding online review exercise 1). We also control for attendance (*ATTD01*) and preview of learning material before lectures/tutorials (*PREV01*) in the first half of the semester, which are proxies for students' motivation. Students who are highly motivated to excel in the course tend to make good preparations for the class by previewing the learning material. Similarly, students with a good attendance record tend to do well in the course (Wong, 2013). We include six indicator variables (*BAD*, *ENF*, *HRM*, *IMS*, *MKT*, *YIC*), representing the six programs from which the students come from. *ECO* is excluded because students from Economics are used as the benchmark group. All the other variables are as previously defined.

Finally, to examine the effect of online review exercise 2 on student performance in the final exam, we run the following regression model:

$$\begin{aligned} \text{FinalScore} = & \alpha + \beta_1 \text{BAD} + \beta_2 \text{ENF} + \beta_3 \text{HRM} + \beta_4 \text{IMS} + \beta_5 \text{MKT} + \beta_6 \text{YIC} + \beta_7 \text{Male} + \beta_8 \text{OVRS} + \beta_9 \text{ATTD01} \\ & + \beta_{10} \text{PREV01} + \beta_{11} \text{ATTD01} * \text{PREV01} + \beta_{12} \text{Log}(\text{TNAE1}) + \beta_{13} \text{ATTD02} + \beta_{14} \text{PREV02} + \beta_{15} \text{ATTD02} \\ & * \text{PREV02} + \beta_{16} \text{Log}(\text{TNAE2}) + \beta_{17} \text{Log}(\text{TNA02}) + \varepsilon \end{aligned} \quad (3)$$

where *FinalScore* is the response variable, representing the final exam score of a student. Our main variable of interest is $\text{Log}(\text{TNAE2})$ (i.e., the logarithm of the total number of times a student accessed the second online review exercise in week 12 when the exercise was held). A positive coefficient on $\text{Log}(\text{TNAE2})$ indicates that the second online review exercise has a positive effect on student performance in the final exam. We control for the level of student effort throughout the semester ($\text{Log}(\text{TNA02})$) (i.e., the logarithm of the total number of times a student accessed the learning material on ICE between week 1 and week 15, excluding access to the online review exercises, attendance page, and online survey). We also control for attendance (*ATTD02*) and preview of learning material before lectures/tutorials (*PREV02*) over the semester. All the other variables are as previously defined.

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