Open educational resources (OER) usage and barriers: a study from Zhejiang University, China

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Published online: 15 August 2015
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Abstract Open educational resources (OER) as an innovation to share educational resources has been influential in past decade and expected to bring changes to higher education worldwide. There is, however, very limited literature on OER usage, especially from the perspective of college students in developing countries, who are often projected as the recipients and beneficiaries of OER. This study was designed to examines Chinese college students’ OER usage and perceived barriers impacting the diffusion of OER. Data was collected during the 2012–2013 academic year at Zhejiang University. A two-part survey instrument was administered to a sample of students (n = 1239). The results show that a significant number of university students have experienced with OER, but there are challenges involved with student, content, interface, and environment related factors that impacted rapid diffusion of OER. Gender was not associated with students’ perceptions about barriers to OER usage, but year in study was. The study highlighted the role of university and faculty members in diffusing the concept and practice of OER and

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recommended OER-related initiatives for faculty members and college students to foster the adoption of OER.

**Keywords**  Open educational resources (OER) ∙ Barriers ∙ Distance education ∙ College students ∙ Post-secondary education

## Introduction

One of the most significant educational innovations of the new millennium is the emergence of open educational resources (OER). MIT launched its Open Courseware (OCW) project in 2001, which started the OER movement (Butcher 2011; Materu 2004). Since then, there has been a rapid development of OCW in both developed and developing countries (Bossu et al. 2012; Carson 2009; Håklev 2010; Hockings et al. 2012; Hodgkinson-Williams & Paskevicius 2012; Lane 2010; Sapiere and Reed 2011; Scanlon 2012; Wolfenden et al. 2012). China, one of the largest developing countries, seized this opportunity as a way to advance its public education system. The Chinese Ministry of Education initiated a scalable investment in OCW in 2003, and since then, additional funding has come from different ministries, provincial and municipal governments, and universities. By 2011, there were 24,446 OCW available online (National CQC Online Information Center 2011).

Existing literature, however, fails to provide sufficient evidence on the utilization of OCW in China as the result of government investment. Furthermore, researchers have recognized the influential role of cultural context in technology adoption (Leidner & Kayworth 2006). Therefore, the purpose of this study is to investigate the usage and barriers of OER utilization from the perspective of Chinese university students. The findings of this study should be informative to other developing countries that are considering the adoption of OER in their higher education systems.

## The development of OER and OER in China

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) hosted a Forum on Open Courseware for Higher Education in Developing Countries in 2002, where the term OER was first adopted worldwide (UNESCO 2002). OER was initially defined as “the open provision of educational resources which is enabled by information and communication technologies, adapted and used by a community of users for non-commercial purpose” (Johnstone 2005, p. 2). In 2007, the Organization for Economic Cooperation and Development (OECD) put forward another definition, which defines OER as “digitized materials offered freely and openly for educators, students, and self-learners to use and reuse for teaching, learning, and research” (OECD 2007, p.10). OER can be categorized into three kinds of resources: (1) learning content: full courses, courseware, modules, learning objects, collections, and journals; (2) tools: software to support the development, use, reuse, and delivery of learning content, including tools that are used for searching, developing, and organizing content, learning management systems, and online learning communities; and (3) implementation resources: intellectual property licenses to promote open publishing of materials, design principles of best practices and localized content.
MIT’s OCW are typical OER in the form of learning content, while open source software such as Moodle and Sakai are forms of learning management systems. Creative Commons (CC) is a different kind of licensing that promotes open publishing of materials. Publications are increasingly using CC instead of traditional intellectual property licenses.

The concept of OER remains minimally recognized in most countries or regions, such as Germany, China, and Sub Saharan Africa (Richter & McPherson 2012; Wang & Zhao 2011; Wolfenden et al. 2012; Lane & Van Dorp 2011). The UNESCO Institute for Information Technologies in Education (IITE) launched its own OER initiatives to promote participation of non-English-speaking countries in the OER movement (UNESCO & IITE 2011). In 2010–2012, UNESCO IITE identified the following factors that might prevent a wider adoption of OER in educational settings:

1. National and institutional strategies for the informatization of education are mainly oriented towards infrastructure and seldom encourage the development of educational content.
2. Educators (and others) lack awareness about the availability of OER and the opportunities it provides.
3. Most people are not familiar with intellectual property rights (IPR); moreover, national IPR regulations are currently incompatible with open licenses.
4. Emerging pedagogical approaches that use OER in countries more advanced in accepting and using OER are yet to be adopted by educators and higher education institutions.
5. Quality assessment and assurance provisions for “kite-marking” OER as being academically and/or pedagogically sound do not exist.
6. The reward/encouragement system for introducing OER into educational practice is non-existent at educational institutions, and the provision of educational content is not considered during instructors’ performance evaluation (Badarch et al. 2012, p. 31).

Allen and Seaman (2011, 2012) found that, although many American academic leaders have become aware of OER’s benefits, they are challenged by the initial investment required to develop OER resources. Developing countries are facing additional technical, economic, social, and cultural-related barriers, such as lack of information technology infrastructure, lack of technical skills, and reluctance to adopt resources developed by other teachers or institutions (Badarch et al. 2012; UNESCO 2002; Wang & Zhao 2011).

Lane and van Dorp (2011) investigated factors impacting diffusion and adoption of OER by examining two typical OER projects—the Multilingual Open Resources for Independent Learning (MORIL) and the Teacher Education in Sub Saharan Africa program (TESSA). They found that institutional support efforts such as awareness raising, strategy building, online pedagogic training, and pilot experiments were critical to OER diffusion and adoption. To successfully diffuse OER, institutions need to appropriately organize skills and competences and promote collaboration. Although studies of OER are increasing, most have been conducted in western contexts and focused on OER production and policies (Glennie et al. 2012; Kanwar 2011; Lane 2010, 2012; Lane & McAndrew 2010; Nikoi & Armellini 2012; Olcott 2012; Phelan 2012). Few studies focus on OER usage in developing countries.

The term “OER” was first introduced to China and promoted among scholars and educators in 2002. In China, OER can be categorized into three groups. (1) Educational resources that are not protected by the Copyright Law of the People’s Republic of China.
These resources include cultural, educational, and literary work available in the public domain that are digitized by libraries and institutions and made available free of charge via the Internet and other means. (2) Educational resources protected by Copyright Laws but under provisions that allow for free use and/or re-use. These resources include any educational materials published under open copyright licenses. (3) Resources that are not explicitly licensed under certain intellectual property licenses and do not reside in the public domain, yet are guaranteed for free public use by government policies (Wang & Zhao 2011). One example of government policies supporting OER initiatives is the Chinese Quality Course (CQC), which was funded by the Chinese Ministry of Education. In announcing the project, the Ministry of Education declared that all funded CQC courses should be posted online without password limitations and open to the general public (Wang & Zhao 2011).

To drive OER, the Chinese government put forward three nationally sponsored projects: (1) CQC Project led by Chinese Ministry of Education; (2) National Cultural Information Resources Sharing Project led by Chinese Ministry of Culture; and (3) the Science Data Sharing Project led by Chinese Ministry of Science and Technology. Among them, the CQC Project is the most influential in Chinese higher education. Initiated in 2003, the main purpose of the CQC project was to use OER to improve the quality of undergraduate education by accelerating the modernization of instructional content. By the end of 2010, 3862 courses from 746 colleges and universities were funded, developed, and posted online as the CQC offerings. Chinese universities pay close attention to the CQC Project because it represents the highest national recognition of their courses. To encourage faculty members to apply for CQC, provincial governments put forward funding for the “Provincial Quality Course” (PQC) Project, and universities put forward funding for the “School Quality Course” (SQC) Projects.

In 2007, a unified portal for all CQCs, PQCs and SQCs, The National CQC Online (http://www.jingpinke.com), was made available to the public by the Higher Education Press. On this website, learners can browse quality courses by discipline, university or level, and there are lists showing the most frequently utilized courses in various categories. Learners can also rate courses and comment on the course content. According to the brief report of Chinese National Quality Courses Online (National CQC Online Information Center 2011), there are 3835 CQCs, 8279 PQCs and 8170 SQCs available on the National CQC Online as of May, 2011. In addition, basic information about 44,832 textbooks was also available on the platform, including textbook title, author(s), publication date, publishing press, brief content introduction, table of contents, and free sample chapters. In 2011, following the world top-ranked universities' practice of putting videos of professors' lectures online, the Ministry of Education put forward another OER project named “Video Open Course” (VOC) Project. Totally, the Ministry selected 103 VOCs in 2011 and the number is expected to reach 500 in 2015. VOCs will be available through institutional or university websites (such as http://www.jingpingke.com, or http://www.icourses.edu.cn/) and commercial websites (such as http://open.163.com; or http://open.sina.com.cn/).

Albeit Chinese OER development is rapid and expected to accelerate, common problems associated with implementation can be categorized as funding, technical, and non-technical issues (Wang & Zhao 2011). Non-technical issues include appropriate incentive structure, accessibility of resources, program administration, quality control and content timeliness. More investigations are needed to explore possible barriers to OER usage from users’ perspectives.

This study aims to do so by examining Chinese college students’ OER usage and perceived barriers impacting the diffusion of OER. Specifically, the research objectives of
the study include: (1) describing college students’ OER usage patterns; (2) describing college students’ perceived barriers to OER usage; and (3) examining the relationship between college students’ selected personal characteristics and their perceptions about possible barriers to using OER.

Research method

Sample

The target population was college students. Zhejiang University (ZJU) was selected as the sample site for the following reasons, (1) ZJU has been an active participant in the CQC Project since 2003; and (2) between 2003 and 2011, ZJU has developed 64 CQCs, 124 PQCs and eight VOCs. ZJU is one of the top-ranked universities in China. Currently, it has seven Faculties and each Faculty is constituted of several colleges and professional schools, with enrollment of approximately 44,000 students in current academic year. A total of 1,200 students were randomly selected from the seven faculties of ZJU to complete a printed survey between September 15 and November 15, 2012. At the same time, the survey was posted on the website, so any student interested could also complete the online version of the same instrument. Hence, the final number of completion included both hardcopy and online surveys.

Instrumentation

To measure college students’ OER usage patterns and perceived barriers, a two-part survey instrument was developed. To ensure participants’ understanding of the definition and the scope of OER used in the study, the OCED’s definition about OER (2007) was presented at the beginning of the instrument. Participants were also informed that OER in this study mainly represents Chinese open course resources in higher education, such as CQCs, PQCs, SQCs, and VOCs. Part one of the survey instrument (eight items) gathered demographic data and participants’ OER usage patterns in five categories: (1) OER usage experience (participants were asked to indicate whether or not they have visited listed OER websites); (2) channels to get to know OER (participants were asked to indicate where they got the information about OER, e.g., other students, faculty members, university advocate, search engine, university website or other channels); (3) purpose of OER usage (participants were asked to indicate why they used OER, e.g., personal learning, getting to know content in areas outside one’s major, etc.); (4) frequency of OER usage (participants were asked to indicate the frequency of using OER, e.g., many times per day, daily, weekly, monthly, etc.); and (5) frequently used OER content (participants were asked to indicate what kinds of OER content they use most frequently, e.g., video, syllabus, online messaging and discussions, text, or other contents). See appendix for the survey items.

Part two of the survey instrument measured participants’ perceptions about possible barriers to use OER (17 items). Rogers’ (2003) model of the innovation-decision process was used as a framework to develop the questions. The model suggests five phases in an innovation adoption process: Knowledge, Persuasion, Decision, Implementation, and Confirmation (Fig. 1). In the Knowledge Phase, the individuals or organizations are first exposed to innovation but lack information about it. In the Persuasion Phase, adopters form favorable or unfavorable attitudes toward the innovation. In the Decision Phase, adopters
weigh the advantages/disadvantages of using the innovation and decide whether or not to adopt. In the Implementation Phase, adopters employ the innovation. In the Confirmation Phase, adopters seek reinforcement of the adoption decision, but may reverse the decision if experience contradicts their expectations. Barriers in any of these phases could hinder adoption of an innovation. According to Rogers (2003), personal variables (personality characteristics, perceived need for the innovation) and social system variables (social system norms, tolerance of deviancy) are important factors impacting innovation adoption in the Knowledge Phase. In the Persuasion Phase, perceived characteristics of innovations are influential, while communication sources are always an important factor in all phases.

As to possible barriers to use OER, OECD (2007) reported that lack of broadband access, inadequate resources to invest in the necessary software and hardware, and lack of the skills needed to use technology hindered using OER. Atkins et al. (2007) pointed out that challenges to OER usage include learning object granularity and format diversity, content quality assessment and enhancement, intellectual property protection, computing and communication infrastructure. Downes’ (2007) study concluded that sustainable OER development needed sound funding, technical, content, and staffing support models. Badarch et al. (2012) also summarized six groups of barriers to the wider integration of OER, including language barriers, technology barriers, economics barriers, legal barriers, awareness and culture barriers, regulations barriers, and pedagogical barriers.

Since the Chinese government invested in OER and domestically developed content, innovation impeding factors related to language, intellectual property, and legal restrictions were not considered in this study. The following four categories of barriers were determined as most relevant. First are student-related barriers, which include five items to examine students’ knowledge and attitude toward OER and how they might decide to use OER. Second, content-related barriers were measured by four items to probe how content and quality of OER would influence students’ usage decisions. Third, interface-related barriers were measured by four items, asking how technical issues might influence students’ decisions about OER. Finally, four items were used to measure environment-related barriers to examine how faculty and university might influence OER usage. A 5-point Likert scale (1 = strongly disagree; 5 = strongly agree) was used (see appendix for the survey items).

To ensure the content and face validity of the questionnaire, four learning technology experts were invited to review the questionnaire independently (including two professors
and two associate professors). Questions and disagreements were addressed in subsequent discussions. Wordings and adjustments were made based on feedback from this expert panel. A pilot test was conducted with 30 randomly selected graduate students from the College of Education at the ZJU. Feedback on wording and completion time was collected and revisions were made accordingly.

**Data collection**

Hardcopy surveys were distributed to students in their classrooms and study sessions and collected with the help of instructors and research assistants over a period of 2 months. At the conclusion of the data collection period, 1239 useful surveys were returned, including 1113 printed (92.75 % response rate) and 126 online surveys. Randomly selected 126 responses collected from printed survey were compared to those 126 online responses by using independent *t* test and the mean values for perceived student-, content-, interface- and environment-related barriers derived from printed survey were 3.24, 3.22, 3.26, and 3.32, respectively; and the mean values for perceived student-, content-, interface- and environment-related barriers derived from online survey were 3.25, 3.18, 3.29, and 3.27, respectively. Results of *t* tests indicated that no statistical differences were found in students’ perceived barriers between these two groups of data (Table 1). Hence, data collected from both printed and online surveys were combined for subsequent analyses.

**Data analysis**

Data were compiled and analyzed using the Statistical Package for Social Sciences (SPSS20.0). Descriptive statistics were used to describe each variable. An exploratory factor analysis (EFA) was performed on the 17 items related to OER usage barriers. Factors with eigenvalues greater than 1 were retained. Items with initial loading below 0.5 and items that cross-loaded were removed (Costello & Osborne 2005). Correlation analysis was used to examine relationships among different factors. Alpha for all statistical procedures was set a priori at 0.05.

| Table 1 | Comparison between responses to printed survey and those to online survey |
|---------|---------------------------------------------------------------|
| **Factors** | **Responses** | **N** | **M** | **SD** | **DF** | **t** | **P** |
| Student-related factor | Responses to printed survey | 124 | 3.24 | 0.88 | 248 | 0.12 | 0.91 |
| | Responses to online survey | 126 | 3.25 | 0.76 | | | |
| Content-related factor | Responses to printed survey | 124 | 3.22 | 0.73 | 248 | 0.40 | 0.69 |
| | Responses to online survey | 126 | 3.18 | 0.60 | | | |
| Interface-related factor | Responses to printed survey | 124 | 3.26 | 0.72 | 248 | 0.37 | 0.71 |
| | Responses to online survey | 126 | 3.29 | 0.70 | | | |
| Environment-related factor | Responses to printed survey | 124 | 3.32 | 0.93 | 248 | 0.45 | 0.65 |
| | Responses to online survey | 126 | 3.27 | 0.84 | | | |

*1 strongly disagree, 2 disagree, 3 neutral, 4 agree, 5 strongly agree*
Results

Among the 1,239 ZJU students who participated the survey, 611 (49.3 %) were male and 628 (50.7 %) were female; 172 (13.9 %) were freshmen, 193 (15.6 %) were sophomores, 253 (20.4 %) were juniors, 244 (19.7 %) were seniors, 249 (20.1 %) were master’s students, 128 (10.3 %) were doctoral students. The survey respondents were nearly evenly distributed among different faculties of the university with a little higher participation from the Faculty of Social Sciences with 168 (13.6 %) students, and the lowest participation rate is from the Faculty of Science with 106 (8.6 %) students. Table 2 shows the details of participants’ distributions in terms of demographical variables of gender, grade and Faculty.

College students’ OER usage patterns

OER usage patterns are summarized in Table 3. Seventy-eight point eight percent of respondents had used OER in one form or another, and only 21.2 % had not used OER. Among the 78.8 % of the students having OER experiences, 26.4 % viewed the National CQC online, 47.1 %, viewed the ZJU Quality Course website, 11.7 % viewed the ZJU VOC website, and 50.4 % had visited other OER websites.

As for channels for learning about OER, 37.1 % indicated that their professors introduced OER to them; 32 % used search engines, 30.3 % used the university website, 22.8 % learned from other students, 14.3 % from a university or college advocate, and 14.3 % from other channels. Some students selected multiple answers because they learned

| Table 2 Participating ZJU students’ demographics (n = 1239) |
|----------------------------------------------------------|
| Personal characteristics                        | Sample | Percent (%) |
| Gender                                      |
| Male                                       | 611    | 49.3        |
| Female                                     | 628    | 50.7        |
| Year in study                               |
| Freshmen                                   | 172    | 13.9        |
| Sophomores                                 | 193    | 15.6        |
| Juniors                                    | 253    | 20.4        |
| Seniors                                    | 244    | 19.7        |
| Master’s students                           | 249    | 20.1        |
| Doctoral students                           | 128    | 10.3        |
| Faculty                                    |
| Faculty of Arts and Humanities (FOAH)       | 119    | 9.6         |
| Faculty of Social Sciences (FOSS)           | 168    | 13.6        |
| Faculty of Science (FOS)                    | 106    | 8.6         |
| Faculty of Engineering (FOE)                | 126    | 10.2        |
| Faculty of Information Technology (FOIT)    | 121    | 9.8         |
| Faculty of Medicine (FOM)                   | 119    | 9.6         |
| Faculty of Agriculture, Life and Environment (FOALE) | 109 | 8.8 |

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Regarding the purpose for using OER, more than half (59.75 %) of the students indicated that they used OER to meet their individual learning needs, 39.4 % used OER to learn about other fields of study, 31.1 % used OER to review presentations of internationally renowned scholars, 16.8 % used OER to review presentations from Chinese renowned scholars, 12.4 % used OER for other purposes. It was clear that a significant number of students used OER to gain opportunities that were otherwise unavailable to them, such as listening to presentations of renowned scholars and exploring other fields.

Table 3  Participating ZJU students’ OER usage status (n = 1239)

| OER usage status                                           | Number (n) | Percent (%) |
|-----------------------------------------------------------|------------|-------------|
| OER usage experience                                      |            |             |
| National CQC online                                       | 327        | 26.4        |
| ZJU Quality Course website                               | 584        | 47.1        |
| ZJU Video Open Course website                            | 145        | 11.7        |
| Other OER websites (such as http://www.icourses.edu.cn/, http://open.163.com; http://open.sina.com.cn/, etc.) | 624        | 50.4        |
| Have OER usage experience                                | 976        | 78.8        |
| Have no OER usage experience                              | 263        | 21.2        |
| Channel to get to know OER                                |            |             |
| Faculty members                                           | 458        | 37.1        |
| Search engine                                             | 395        | 32.0        |
| University website                                        | 374        | 30.3        |
| Other students                                            | 281        | 22.8        |
| University or college advocate                            | 176        | 14.3        |
| Other channels                                            | 176        | 14.3        |
| Purpose of using OER                                       |            |             |
| To assist personal learning                               | 736        | 59.7        |
| To get to know content in areas outside one’s major        | 484        | 39.3        |
| To view international prestigious scholars’ presentation  | 383        | 31.1        |
| To view Chinese prestigious scholars’ presentation         | 207        | 16.8        |
| Other purposes                                            | 153        | 12.4        |
| Frequency of using OER                                     |            |             |
| Monthly                                                   | 437        | 35.0        |
| Weekly                                                    | 287        | 23.0        |
| Daily                                                     | 55         | 5.0         |
| Many times per day                                        | 10         | 1.0         |
| Other frequencies                                         | 443        | 36.0        |
| Most frequently used OER content                          |            |             |
| Video                                                     | 742        | 60.2        |
| Text                                                      | 556        | 45.1        |
| Syllabus                                                  | 247        | 20.0        |
| Online messaging and discussions                          | 216        | 17.5        |
| Other contents                                            | 153        | 12.4        |

about OER from multiple sources. Professors, university websites, and word of mouth from other students were the primary channels.
In terms of frequency of OER usage, 35% indicated that they used OER monthly, 23% used OER weekly. Only a small percentage of students used it more frequently, 5% of them used OER daily and 1% used OER more than one time per day.

As for most frequently used OER content, video was the most popular with 60.2% indicating they have reviewed videos, while 45.1% listed text, 20% listed syllabi, 17.5% listed online messaging and discussions, and 12.4% listed other contents.

College students’ perceived barriers to OER usage

To better understand the types of barriers perceived by students, an exploratory factor analysis (EFA) using the Principal-axis method as the extraction method and Varimax with Kaiser Normalization as the rotation method (SPSS 20.0) was conducted. This factor analysis approach yields factor loadings that are Pearson correlation coefficients between items and the underlying factors and they are maximized to have items loaded on as few factors as possible (Tabachnick & Fidell 2007). Rotated factor loadings of EFA presented in Table 4 revealed that the barriers fell into four categories or four factors. They are student-related factor, content-related factor, interface-related factor, and environment-related factor. All four factors had acceptable loadings higher than 0.5 (Costello & Osborne 2005) and they corresponded to the four categories of barriers initially conceptualized. No items were cross-loaded.

To further confirm the factor loading patterns among the 17 items, mean, SD, and reliability of each factor were analyzed and the results were presented in Table 5. According to their Cronbach’s Alpha value, all of the four factors met the factor analysis criteria and the items appeared to group together well (Costello & Osborne 2005). A close examination of the four factors showed that the students’ greatest concern was the interface-related factor \(M = 3.33, SD = 0.62\), followed by the student-related factor \(M = 3.31, SD = 0.66\), the content-related factor \(M = 3.22, SD = 0.65\) and, lastly, the environment-related factor \(M = 3.13, SD = 0.84\).

The relationships between college students’ selected personal characteristics and their perceptions about possible barriers to using OER

Objective three was to examine the relationship between perceived barriers toward OER usage and users’ personal characteristics. A t-test about mean factor scores of male versus female students was utilized to measure possible gender differences in students’ perceptions of the four factors. As Table 6 shows, there were no gender differences in students’ perception about the four factors.

An F-test about mean factor scores of students in different years in study was utilized to measure differences in “year in study” on students’ perceptions of the four factors. As Table 7 shows, “year in study” was associated with two factors \((p < 0.05)\): (1) student-related factor, \(F(5, 1196) = 6.10\); and (2) environment-related factor, \(F(5, 1196) = 3.60\). Sophomores tended to have the strongest agreement about the student-related factor, followed by freshmen, juniors, doctoral students and master’s students. Freshmen tended to have the strongest agreement about the environment-related factor, followed by master’s students, doctoral students, sophomores, seniors and juniors. There was no year in study difference in students’ perceptions about content-related factors and interface-related factor.
Discussion and implications

OER usage level

The study found that more than three-fourths of surveyed ZJU students had OER usage experience and that they visited diverse OER-related websites, including both the university website and other organizational or commercial websites. The major channels for students to learn about OER were faculty members, university websites, and other students (Table 3). This reveals that, in hierarchical societies such as China, faculty members and the university official channels can be very influential in the diffusion of educational innovations. They have
authority in the mind of the students, and thus, significantly influence students’ decisions. Increasing faculty members’ awareness and usage about OER and publishing more OER-related announcements or news on the official university websites would be very helpful to increase OER adoption and usage among college students.

Major purposes for students to use OER were to assist their individual learning, expand their scope of knowledge, and gain access to internationally and nationally renowned scholars whom the students might not have access to otherwise (Table 3). This finding echoes the proposition that OER is to share resources and provide access (Johnstone 2005) to improve equal educational opportunities. It can be expected that, to a certain degree, OER would accelerate internationalization of higher education resources not only in area of instructional content but also in area of faculty and students’ perspectives and thoughts. The advantage is that without leaving the campus, students could have the opportunity to listen to national and international scholars on whatever topics that interest them and communicate directly with scholars and peers from all over the world. This has the potential to fundamentally influence, expand, and change the learning experiences of the college students around the world.

In terms of usage frequency, this study found that approximately one-third of ZJU students used OER monthly, about one-fourth used OER weekly, and very few students used OER daily or more frequently (Table 3). This suggested that OER is not yet a mainstream source of learning in comparison with students’ daily visits to the classroom. It is understandable that students are still required to attend regular classroom activities and OER remains a source for voluntary supplemental learning. As an indicator of OER adoption status, the frequency of OER usage might hint at the importance of OER in students’ learning and the findings implicate that ZJU students currently look OER as supplementary resources only. Considering the fact that Chinese government has made a significant investment in OER development that aimed at improving the quality of Chinese higher education, this might be a disappointment. More advertising activities and substantial initiatives to innovatively promote the utilization of current OER resources might be necessary.

This study found that video is the most popular form of OER being used, followed by text, syllabus, and online messaging and discussions (Table 3). This finding is not surprising because video is one of the most popular multimedia formats. It is a global trend to use videos, especially micro or short videos that are not more than 20 min in length, to record instructional contents (Guo et al. 2014). This finding confirmed the popularity of video as a main format for web-based distance education. This study did not address language barriers related to video.
Barriers toward OER usage

Ease of use and users’ attitudes toward OER are crucial. At the same time, institutional supporting efforts to raise awareness, strategy building, online pedagogic training, and pilot experimentation were also critical. This finding is supported by previous studies (Allen & Seaman 2011, 2012; Badarch et al. 2012; UNESCO 2002; Wang & Zhao 2011). In addition, the findings of this study confirmed Rogers’ diffusion of innovation model by showing that there were multiple factors impacting diffusion of OER among college students, including perceived characteristics of OER (traits of content and interface), personal variables (adopters’ personal characteristics and their perceptions), social variables (institutional norms and support) and communication sources (personal and mass media communication).

To increase the adoption of OER, multiple strategies are needed. For example, OERs need to be more attractive and user-friendly. OER developers need to optimize website interface by expanding bandwidth, improving navigation and adding interactive functions. At the same time, universities can implement orientation programs to help college students

Table 7 Distribution of participation ZJU students’ perceptions about possible barriers to OER usage by year in study (n = 1239)

| Factors                  | Year in study | N   | M    | SD   | DF | F    | p     |
|--------------------------|---------------|-----|------|------|----|------|-------|
| Student-related factor   | Freshmen      | 162 | 3.40 | 0.67 | 5  | 6.10**| 0.00  |
|                          | Sophomores    | 182 | 3.45 | 0.66 | 1191 |       |       |
|                          | Juniors       | 251 | 3.37 | 0.67 | 1196 |       |       |
|                          | Seniors       | 238 | 3.25 | 0.61 |    |      |       |
|                          | Master’s students | 244 | 3.17 | 0.64 |    |      |       |
|                          | Doctoral students | 120 | 3.19 | 0.73 |    |      |       |
| Content-related factor   | Freshmen      | 162 | 3.12 | 0.63 | 5  | 1.21 | 0.30  |
|                          | Sophomores    | 180 | 3.25 | 0.63 | 1186 |       |       |
|                          | Juniors       | 250 | 3.24 | 0.69 | 1191 |       |       |
|                          | Seniors       | 237 | 3.19 | 0.65 |    |      |       |
|                          | Master’s students | 244 | 3.25 | 0.66 |    |      |       |
|                          | Doctoral students | 119 | 3.27 | 0.61 |    |      |       |
| Interface-related factor | Freshmen      | 161 | 3.25 | 0.66 | 5  | 1.52 | 0.18  |
|                          | Sophomores    | 182 | 3.40 | 0.66 | 1187 |       |       |
|                          | Juniors       | 251 | 3.33 | 0.62 | 1192 |       |       |
|                          | Seniors       | 237 | 3.33 | 0.59 |    |      |       |
|                          | Master’s students | 243 | 3.37 | 0.61 |    |      |       |
|                          | Doctoral students | 119 | 3.25 | 0.60 |    |      |       |
| Environment-related factor | Freshmen     | 162 | 3.27 | 0.87 | 5  | 3.60*| 0.03  |
|                          | Sophomores    | 182 | 3.16 | 0.86 | 1191 |       |       |
|                          | Juniors       | 251 | 2.98 | 0.79 | 1196 |       |       |
|                          | Seniors       | 238 | 3.04 | 0.86 |    |      |       |
|                          | Master’s students | 244 | 3.21 | 0.81 |    |      |       |
|                          | Doctoral students | 120 | 3.18 | 0.81 |    |      |       |

1 strongly disagree, 2 disagree, 3 neutral, 4 agree, 5 strongly agree
* correlation is significant at p < 0.05
** correlation is significant at p < 0.01
become accustomed to web-based learning, make an effort to advocate OER as an alternative tool for learning both on campus, online, and off-campus and encourage faculty members to use OER and web-based learning resources in their courses.

Relationships between perceived barriers and user characteristics

No gender differences in OER usage might be unique to China because of equal participation of male and female students in Chinese higher education. As to year of study, the findings suggest the longer students stay in the university, the more they become familiar with OER and online learning method. Freshmen are new on campus and are least familiar with university websites and OER. To help freshmen become familiar with OER more quickly, universities should make OER part of student orientation and teach how to gain access and utilize these resources. It also suggests that there is little to no exposure to online education in Chinese secondary education systems.

Interestingly, in the case of masters’ and doctoral students, years of study did not show increase in OER usage. It could be because that the CQC Project is mainly aimed to improve the quality of undergraduate education, the content is not suitable to graduate students, and the faculty members did not emphasize the relevancy of OER as a supplemental learning resources. Since graduate students are an important group of students in higher education system, they should not be excluded in the OER movement and research has shown that graduate students might be good contributors to OER development (Hodgkinson-Williams & Paskevicius 2012).

Conclusion and limitation of the study

The findings of this study indicate that the university is an important place for students to get to know OER. The more students were introduced to OER in the university, the more likely they would use OER. However, OER was used mostly as a supplementary learning resource and has not become part of the formal curriculum in Chinese higher education. To expand the impact of OER and to effectively propel quality education reform in higher education, universities should carry out special programs to introduce OER to their students. As other developing countries are looking to utilize OER resource, the findings of this study should inform them of potential barriers and possible strategies to overcome these barriers in the context of their own culture and institutional environment.

One study limitation is that the measurement tools still need improvement. The 17 statements used in the instrument present a general description of the barriers to OER usage, but do not take account of the differences between disciplines. Each discipline may have its own preferred features. Therefore, a discipline-specific instrument may reflect more authentically and effectively on students’ actual perceptions about OER usage. Another limitation is that the study was conducted at one Chinese university and the data was self-reported. It is possible to use learner analytics collected by these online courses if that was part of the design, however, it is beyond the exploratory scope of this study.

Acknowledgments  This work was supported by Grants from the National Social Science Foundation of China (13CGL113) and the Zhejiang Social Science Foundation Project (13ZJQN035YB).
Appendix: Survey instrument

Part One: students’ personal information and their OER usage status

(1) Your gender:
   A. Male
   B. Female

(2) Your grade:
   A. Freshman
   B. Sophomore
   C. Junior
   D. Senior
   E. Master’s student
   F. Doctoral student

(3) Your Faculty (please indicate):____________________________

(4) OER usage experience (multiple choices)
   A. The National CQC online
   B. ZJU Quality Course website
   C. ZJU Video Open Course website
   D. Other OER websites ((http://www.icourses.edu.cn/, http://open.163.com;
      http://open.sina.com.cn/, etc)
   E. Never visit any OER websites

(5) Channel to get to know OER (multiple choices)
   A. Other students
   B. Faculty members
   C. University or college advocate
   D. Search engine
   E. University website
   F. Other channels____________________________

(6) Purpose of using OER (multiple choices)
   A. To assist personal learning
   B. To get to know content in areas outside one’s major
   C. To view international prestigious scholars’ presentation
   D. To view Chinese prestigious scholars’ presentation
   E. Other purposes____________________________

(7) Frequency of using OER (single choices)
   A. Many times per day
   B. Daily
   C. Weekly
   D. Monthly
   E. Other frequencies____________________________

(8) Most frequently used (multiple choices)
   A. Video
   B. Syllabus
   C. Online messaging and discussions
   D. Text
   E. Other contents____________________________
Part Two: students’ perceptions about barriers to OER usage

| Statements                                                                 | Scales |
|----------------------------------------------------------------------------|--------|
| **Student-related factor**                                                 |        |
| I am not familiar with OER.                                                |        |
| I do not have time to use OER.                                             |        |
| I do not like to learn using online method.                                |        |
| I am not used to learning online.                                          |        |
| Using OER has little impact on my learning outcome.                       |        |
| **Content-related factor**                                                 |        |
| OER covers limited subjects and disciplines.                              |        |
| OER repository has limited contents that I am interested in.              |        |
| Contents of OER repository are not high quality.                          |        |
| OER repository is not updated frequently.                                  |        |
| **Interface-related factor**                                               |        |
| Navigation of OER repository is not user-friendly and time-consuming.     |        |
| It is time consuming to download OER resources.                           |        |
| It is difficult to visit Websites of OER.                                 |        |
| There are no suitable platform for communication and interaction on the websites of OER. |        |
| **Environment-related factor**                                             |        |
| No faculty members introduced OER to me.                                  |        |
| No faculty members encouraged me to use OER.                              |        |
| There is no OER-related news or information on my university website.     |        |
| There are no OER-related links available on our university website.       |        |

References

Allen, I. E., & Seaman, J. (2011). *Going the distance: Online education in the United States, 2011*. Retrieved from http://www.onlinelearningsurvey.com/reports-goingthedistance.pdf

Allen, I. E., & Seaman, J. (2012). *Growing the curriculum: Open education resources in U.S. higher education*. Retrieved from http://www.onlinelearningsurvey.com/reports-growingthecurriculum.pdf

Atkins D. E., Brown, J. S., & Hammond A. L. (2007). *A review of the Open Educational Resources (OER) movement: Achievements, challenges, and new opportunities*. Retrieved from http://www.hewlett.org/uploads/files/ReviewoftheOERMovement.pdf

Badarch, D., Knyazeva, S., & Lane, A. (2012). Introducing the opportunities and challenges of OER: The case of the Commonwealth of Independent States and the Baltic States. In J. Glennie, K. Harley, N. Butcher, & T. van Wyk (Eds.), *Open educational resources and change in higher education: Reflections from practice* (pp. 27–39). Vancouver: Commonwealth of Learning.

Bosu, C., Bull, D., & Brown, M. (2012). Opening up down under: The role of open educational resources in promoting social inclusion in Australia. *Distance Education, 33*(2), 151–164. doi: 10.1080/01587919.2012.692050.

Butcher, N. (2011). *A basic guide to Open Educational Resources (OER)*. Vancouver, Canada: Commonwealth of Learning. Retrieved from http://creativecommons.org/licenses/by-sa/3.0

Carson, S. (2009). The unwalled garden: Growth of the open courseware consortium, 2001–2008. *Open learning, 24*(1), 23–29. doi: 10.1080/02680510802627787.

Costello, A. B. & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation, 10*(7), 1–9. Retrieved from http://pareonline.net/pdf/v10n7.pdf
Downes, S. (2007). Models for sustainable open educational resources. *Interdisciplinary Journal of Knowledge and Learning Objects, 3*(1), 29–44.

Glennie, J., Harley, K., & Butcher, N. (2012). Introduction: Discourse in the development of OER practice and policy. In J. Glennie, K. Harley, N. Butcher, & T. van Wyk (Eds.), *Open educational resources and change in higher education: Reflections from practice* (pp. 1–12). Vancouver, Canada: Commonwealth of Learning. Retrieved from http://creativecommons.org/licenses/by/3.0.

Guo, P. J., Kim, J., & Rubin, R. (2014). How video production affects student engagement: An empirical study of MOOC videos. Paper presented at the first ACM Conference on Learning @ scale, March 4–5, 2014. Retrieved from 10.1145/2556325.2566239

Häkle, S. (2010). *The Chinese national top level courses project: Using open educational resources to promote quality in undergraduate teaching*. Unpublished Master Thesis, University of Toronto, Toronto, Canada.

Hockings, C., Brett, P., & Terentjevs, M. (2012). Making a difference—Inclusive learning and teaching in higher education through open educational resources. *Distance Education, 33*(2), 237–252. doi:10.1080/01587919.2012.692066.

Hodgkinson-Williams, C., & Paskevicius, M. (2012). The role of postgraduate students in co-authoring open educational resources to promote social inclusion: A case study at the University of Cape Town. *Distance Education, 33*(2), 253–269. doi:10.1080/01587919.2012.692052.

Johnstone, S. (2005). *Open educational resources and open content*. Paper presented at the Internet Discussion Forum on Open Educational Resources, Open Content for Higher Education, October 24–December 2, 2005. Retrieve from http://www.unesco.org/iiep/virtualuniversity/media/forum/oer_forum_session_1_note.pdf.

Kanwar, A. (2011). *Open education resources: Lessons from the COL experience*. Keynote address (via video) to OER Africa, 16–18 May 2011. Retrieved from http://www.col.org/resources/speeches/2011presentation/Pages/2011-05-16b.aspx.

Lane, A. (2004). *Open source courseware: A baseline study*. Washington, DC: The World Bank.

National CQC Online Information Center. (2011). *The brief report of Chinese National Quality Courses Online* (2011, Volume 5). Retrieved from http://news.jingpinke.com/details?uuid=25cb50f9-1309-1000-a536-f9bd00bff4d1&objectId=oid:25cc9834-1309-1000-a55a-f9bd00bff4d1

Nikoi, S., & Armellini, A. (2012). The OER mix in higher education: Purpose, process, product, and policy. *Distance Education, 33*(2), 165–180. doi:10.1080/01587919.2012.697439.

OECD (2007). *Giving knowledge for free: the emergence of open education resources*. Retrieved from http://www.oecd.org/edu/ceri/38654317.pdf

Olcott, D. Jr. (2012). OER perspectives: emerging issues for universities. *Distance Education, 33*(2), 283–290. doi:10.1080/01587919.2012.700561.

Phelan, L. (2012). Politics, practices, and possibilities of open educational resources. *Distance Education, 33*(2), 279–282. doi:10.1080/01587919.2012.692070.

Richter, T., & McPherson, M. (2012). Open educational resources: Education for the world? *Distance Education, 33*(2), 201–219. doi:10.1080/01587919.2012.692068.

Rogers, E. M. (2003). *Diffusion of innovation* (5th ed.). New York, NY: The Free Press.

Sapire, I., & Reed, Y. (2011). Collaborative design and use of open educational resources: A case study of a mathematics teacher education project in South Africa. *Distance Education, 32*(2), 195–211. doi:10.1080/01587919.2011.584847.

Scanlon, E. (2012). Open educational resources in support of science learning: Tools for inquiry and observation. *Distance Education, 33*(2), 221–236. doi:10.1080/01587919.2012.692053.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Needham Heights, MA: Allyn & Bacon.
UNESCO (2002). *Forum on the impact of open courseware for higher education in developing countries.* Retrieved from http://unesdoc.unesco.org/images/0012/001285/128515e.pdf

UNESCO & COL. (2011). *UNESCO/COL guidelines for open educational resources (OER) in higher education.* Retrieved from http://unesdoc.unesco.org/images/0021/002136/213605e.pdf

Wang, C., & Zhao, G. (2011). *Open educational resources in the People’s Republic of China: Achievements, challenges and prospects for development.* Retrieved from http://iite.unesco.org/pics/publications/en/files/3214700.pdf

Wolfenden, F., Buckler, A., & Keraro, F. (2012). OER adaptation and reuse across cultural contexts in Sub Saharan Africa: Lessons from TESSA (Teacher Education in Sub Saharan Africa). *Journal of Interactive Media in Education,* (3), 1–16. Retrieved from http://files.eric.ed.gov/fulltext/EJ976456.pdf

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