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Full Length Research Paper

A multi-year study of teaching an online computer literacy course in a medical university: A lesson learnt

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In this research, we aim to understand the effectiveness of adopting educational technologies in a computer literacy course to students in a medical university. The course was organized with three core components: Open Education Resources (OER) reading, a book club, and online game competition. These components were delivered by a learning management system (LMS). Participating records of LMS and survey results are analyzed. This study has shown positive results in terms of students' self - evaluation and online participation rate.

Key words: Educational technology, learning management system, computer literacy, open educational resource.

INTRODUCTION

The professional society for educational technology, the Association for Educational Communications and Technology (AECT), had defined: "educational technology as the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources." It emphasizes on integrating diverse media to improve teaching and learning. Most educational techno-logies are implemented through information technologies. Learning management systems (LMSs) may become one of the most common means in providing effective teaching and learning (Junco and Clem, 2015).

Using LMS, students can gain more access to class materials and video lectures instructors deployed. In LMS, synchronous online discussions provide valuable profiles for evaluating different pedagogical interventions (Kovanović et al., 2015).However, both students and faculty need help to make the best practice of educational technology (Abelson et al., 2011). To provide these assistance, various educational strategies have been examined, such as, shared mental model (Sikorski et al., 2011), collaborative group modeling (Lee et al., 2014), meta-analytic evaluation (Adedokun et al.,2014), peer instruction (Vickrey et al., 2015), blended learning (Graham et al., 2013), virtual intercultural interaction (O'Dowd, 2013), and role assignment and participation (Xie et al., 2014). Through such techniques, educational technology can improve students' performance and

instructor-independent. However, the study also shows that the student participation rates were extremely variable (Wolter et al., 2012). In many researches, educational technologies were pedagogical tools developed for teachers. As the self-regulated learning becomes a relevant and valuable concept in higher education (Cassidy, 2011), the implementation of educational technologies need to consider further on various learning styles of students. In this research, through collecting both objective and subjective data for the past six years from a computer literacy course using LMS. We would like to demonstrate the effectiveness of innovative course activities design, such as using OERs, book club, and game in an online course.

The concept of OpenCourseWare (OCW) was initiated by Massachusetts Institute of Technology (MIT) in 2000 (Yue and Chen, 2004; Yue and W., 2004). Beginning in 2002, Hewlett Foundation founded various developments of open educational resources to improve quality of teaching and learning. MIT's OCW was one of the funded programs (Atkins et al., 2007). By 2006, the OCW Consortium included more than 100 universities. MIT had published 1800 courses by fall 2007 (Abelson, 2008a). Most OCWs consist of teaching materials, sample assignments and quizzes, offered weekly. Recently, UNESCO announced open education resource (OER) in its Paris declaration. The OERs include the publication of open courses that anyone may access on the Internet and re-use (DeVries, 2013). Due to the international promotion of OCW and OER, projects such as teacher education in sub Saharan Africa (TESSA) program (Murphy and Wolfenden, 2013) have been reported to drive pedagogical changes. In China, Chinese Quality Course (CQC) project was launched in 2003 to promote the awareness of OER (Hu, Li, Li, and Huang, 2015). With the growth of OERs, search tools or platforms have been developed. OER repositories had been built as well (Marcus-Quinn and Diggins, 2013). Studies such as metadata(Tang et al., 2013) and folk semantic (Shelton et al., 2010) have been reported.

To monitor the quality of online programs and students' performance, students' satisfaction surveys have been used (Kuo et al., 2014). Many aspects of online learning self-efficiency has been evaluated, such as interaction between classmates and instructors, and online platform handling (Shen et al., 2013). During the past decade, information literacy has been listed as a core competence in health science education. American Library Association (ALA) published the 'Information Literacy Competency Standards for Higher Education' in 2000. It states that 'Information literacy' is common to all disciplines, to all learning environments, and to all levels of education. 'Information literacy' enables learners to master content, to extend their investigations, to become more self-directed, and assume greater control over their own learning. Information technology skills relate to information literacy. At present, students should be able to learn skills of critical thinking and problem-solving, collaboration across networks, and accessing and analyzing information (Nielsenet al., 2014).To achieve a wide variety of academic, work-related, and personal goals, an individual needs training in information technology skills. In many higher education organizations, information literacy or computer literacy courses had been added into the curriculum. A computer literacy course for life sciences may include modules such as, web-based project repositories, databases, background literature research, data analysis, and presentation (Smolinski, 2010). For students with life science majors, information literacy courses consisting of basic computer concept, library usage, and applications in healthcare may be designed into a curriculum. In this research, we would like to know if a computer literacy course is effective to students in a medical university with adopting educational technologies. Both quantitative and qualitative analyses of students' performance and feedback were preformed and will be presented. The analytics of LMS data will be one of the means to present the effectiveness of course activities. Moreover, we would also like to know if student majors affect their learning outcomes. If any, what would be the possible cause?

MATERIAL AND METHODS

Course sample

The basic computer concept (BCC) course is an online computer literacy course. The course is implemented as an entry-level election for undergraduate in a medical university. Topics include introduction to hardware, software, Internet, information security and privacy, copyright and creative commons, and related applications. Students are expecting to spend 2 h efforts each week for 17 weeks to finish the course. The objectives of this introductory course are (1) how to use information technology (IT) tools to present their ideas, (2) where to find answers or resources of their homework or research through Internet or databases, and (3) how to cooperate with each other through internet.

The BCC course is delivered through the university's LMS. The LMS provides functions for delivering all course activities. Topics and instructions are released on a weekly basis. Students are required to give their feedback through discussion forums or surveys. There are three innovative activities provided in this course:

1. Self-learning from Open Education Resources (OER).
2. Cooperative learning from a Book club.
3. Game-learning from an online Jeopardy-like game.

The course has been offered for several years. Enrollments are also open to students of various colleges or schools from time to time. Approximately 60 students enroll in each academic year. Objective data such as user reading clicks, reading time and discussion rate are collected directly from system, while subjective data are gathered through student surveys, writing assignment and peer reviews. By 2013, the BCC course had been offered for 7 consecutive years. A total of 441 students had enrolled, with 90% of them being non-native speakers of English. Only records of 374

students taking the course after the LMS change in 2008 were studied in this research.

Using OER

An OER, 'Computer Science-E1: Understanding computers and the internet' (E1), is the primary knowledge source for the course studied in this research. This OER was used at Harvard University Extension School, and was first published in fall, 2005. It is a video courseware filmed in the classroom. The first version was filmed at Harvard University and consisted of 14 lectures with David Malan as the lecturer. David is one of the pioneers in filming OERs of computer science. A newer version with 9 lectures was filmed in spring 2011. David's apprentice, Dan Armendariz, and David Malan were the lecturers. The courseware is under a Creative Commons Attribution-Non commercial-Share Alike 3.0 Unsupported License. The original web site of E1 lists course highlight in one page, which is easier for self-learning. To integrate the OER, we add more selected topics in the LMS and arranged links to the videos. After examining the course videos, students are required to submit the weekly assignments. Progress of student self-learning is monitored automatically by the LMS.

Book club

The book for this activity is "*The Pattern on the Stone*", by W. Daniel Hillis, and consists of 9 chapters. Students are divided into 9 groups. Each group is assigned to read one chapter of the book, respectively. Each group after the reading makes a video presentation and shares the learning with other groups. During the semester, 3 presentations each week for 3 weeks are allotted for these group activities. All students give evaluation and feedback on each presentation as part of the course requirement.

Online Jeopardy-like game

A Jeopardy game, featuring categories and graduated answer values, is a popular quiz competition. The online competition in the BCC course consists of a 3 week activity. In the preparation phase, each team submits a category and 5 quizzes related to topics learnt from the course. Each quiz is labeled a value from 100 to 500.The game is a role-based competition. There are three roles in this competition, the chairman, the secretary general, and the spokesperson. When the spokesperson post questions, the secretary generals of other team could answer these posted questions. Then, the chairman has to check the correctness of answers and determine who win the score. Competition teams with 4 to 6 students are formed and each team chooses persons to assume the 3 roles respectively. During the competition, each team shall follow the defined instructions to find the best strategy of obtaining the highest score and win. All of these activities are accomplished by using functions provided by the LMS.

Data collection

The standardized end-of-semester learning survey consists of 15 scale questionnaires related to course satisfaction plus 1 open question. Another survey at the end of semester focusing on e-learning experiences presents 20 scale questionnaires and 1 open question. Peer reviews are collected at the end of the book club and online competition, respectively. There are two kinds of peer

reviews, in-team and between-team. Between team, peer review is done after the book club presentation, each student uses a rubric rate in the presentation team. The in-team peer review is for team members to evaluate each other. The total point of each student earned is calculated as a portion of his or her final grade. All these data are collected by LMS. Moreover, in the LMS logs every click of a user on a content page (a view) as well as the time between one click to another defines the 'reading time'.

Outcome assessment

Three primary outcomes were collected and assessed: (1) the engagement of learners with the activities, (2) participation of online activities, and (3) grading from various assignments. Quantitative and qualitative analyses of surveys provided the engagement data. Content analyses of the open questions were used for qualitative evaluation. Participation data came from LMS logs. Quantitative descriptive statistical analyses were related to the participation and grades. Moreover, in this research, the major of a student was used as one of the variables, and performance differences among majors were analyzed.

RESULTS

Engagement with the activities

A total of 371 student surveys were used in this research. Overall, 65% of the students claimed that they had read more than 75% of OER content. There were 30% of students who considered the Harvard content as the most difficult learning activity. Only 7.5% of students liked the English speaking OERs. The major reason was the language barrier. Some students suggested video subtitles or lecture notes which would help learning. Nearly 35% of students agreed that courseware from prestigious universities was motivating their learning. Only 9.5% of students thought online competition was impressive. Merely 15.6% of students considered book club interesting. General speaking, 46% of students liked this course to be an e-learning course. Time-flexibility and activity-diversity were the two major benefits from this course. More than a half of students considered participation of course activities as "virtual teams" was hard since many needed to call for help on keeping their teammates in touch.

Participation of online activities

Views and discussions generated by students and collected by the LMS were counted for activity participation. From 2008 to 2013, a total of 139,629 views and 426 teaching materials were recorded. Views per weeks per year statistics are shown in Figure 1. Total views per week are presented in Figure 2. The first peak appears between week 4 and 8 when the first team activity starts. The second one is between week 10 and
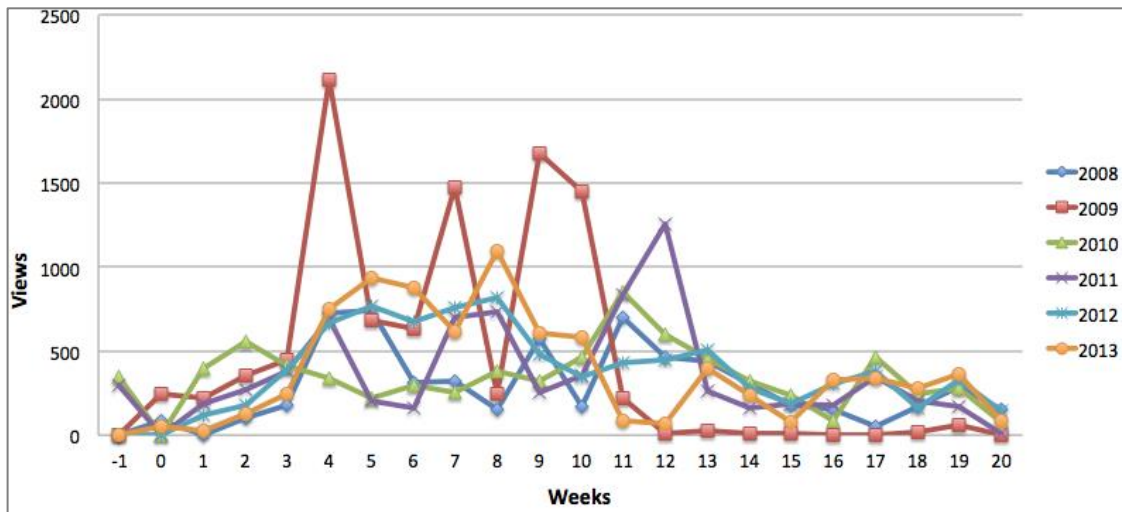
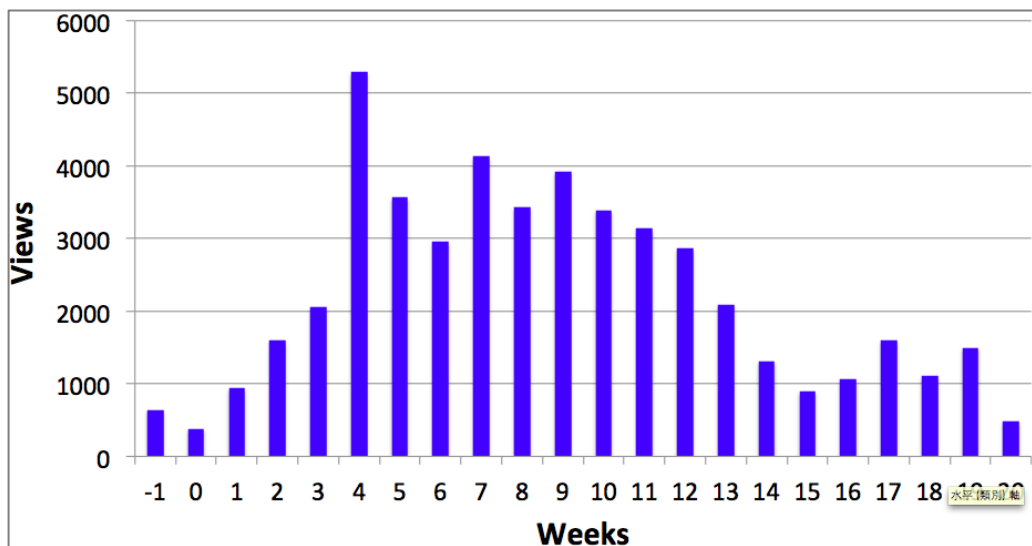**Figure 1.** Student views in weeks of each year's course.

Figure 2. Total student views in each week.

12, when the book club activity begins. The third is around week 17 when the online competition kicks in. According to the LMS logs, the video, how to make a presentation video, apparently was the most viewed teaching material. Following "the instruction of the book clubs" came second. Among the 4,130 discussions, there was a mean of 11 discussions per student with a median of 8 which was recorded. A medical student hit the highest frequency of 62 discussions.

Grading from various assignments

Both in-team and between-team peer reviews of team

presentations represented a portion of the team presentation score. Final grade of a student came from homework, team presentation, competition scores, online activities, as well as peer reviews. The average of student grades was 82.2% with a median of 87.4%. A positive correlation between a student's final grade and his/her course reading records was demonstrated, as shown in Figure 3. Students who spent more time on the learning content generally scored higher in grades.

Differences among majors

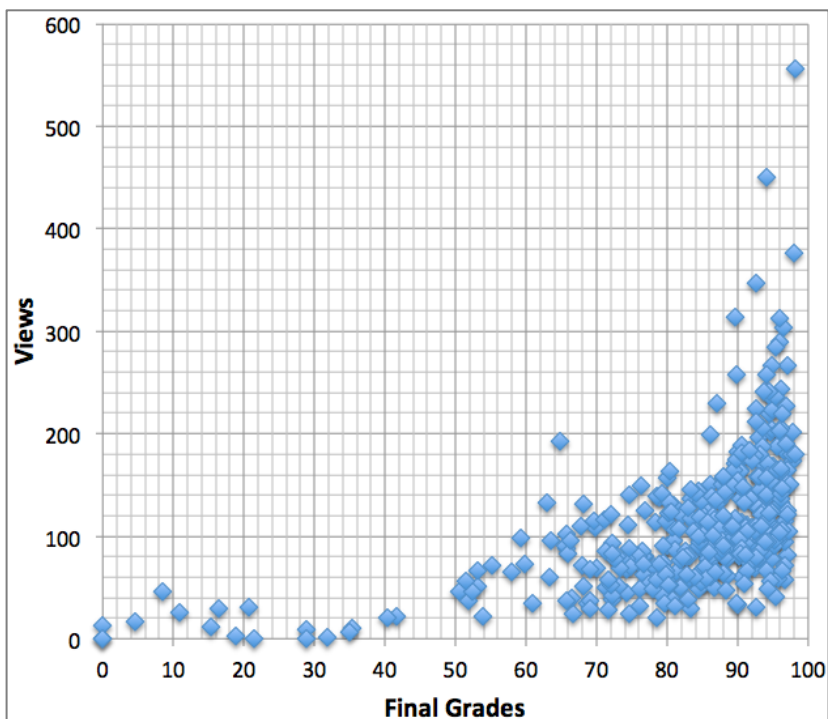The BCC course is a general election course for all

Figure 3. Content views versus final grades.

Table 1. Average grades of students in different majors.

Majors	*n*	Drop-out	Average	*SD*	Max
Medicine	82	0	83.16	18.04	97.85
Dental	46	0	85.36	15.69	97.50
Pharmacy	59	1	86.06	8.90	98.10
Med Tech	27	0	78.79	14.23	96.00
Nursing	14	0	76.57	21.27	94.10
Nutrition	53	0	84.51	12.19	97.10
Public Health	25	0	72.24	24.31	97.10
Health Administration	9	0	83.08	11.65	96.40
Respiratory Therapy	11	1	79.38	10.04	98.04
Gerontology Health Mgt	15	0	82.42	16.33	98.19
Dental Tech.	22	0	83.80	11.68	96.20
Allied Universities	11	1	68.31	20.53	93.85

students in a medical university. Enrolled students vary in their majors and in academic years. In this survey, 22% of enrolled students are from school of medicine and 15.8% from school of pharmacy. Students' performances in their majors are shown in Tables 1 and 2. Comparing the average grades, students in pharmacy appears to score slightly higher than all other medical students. Comparing the records of views and discussions, students in public health and nursing tend to view less and talk less.

DISCUSSION

Many interesting videos can be introduced to non-computer science major students to facilitate their computer literacy. A course designed both for those with little, if any, computer experience and for those who use

Table 2. Average participation data of students in different majors.

Majors	n	Discussion	View	V/D
Medicine	82	11.4	111.4	9.8
Dental	46	13.1	119.1	9.1
Pharmacy	59	11.5	116.3	10.1
Med Tech	27	10.0	102.3	10.3
Nursing	14	8.7	97.1	11.1
Nutrition	53	9.9	104.0	10.5
Public Health	25	7.3	96.8	13.2
Health Administration	9	10.9	107.4	9.9
Respiratory Therapy	11	11.8	122.0	10.3
Gerontology Health Mgt	15	13.1	129.7	9.9
Dental Tech.	22	11.9	104.1	8.8
Allied Universities	11	11.5	88.1	7.6

Table 3. Documents and discussions done by students in the BCC course.

Semester	Documents	Discussion
2008	470	294
2009	464	678
2010	631	764
2011	370	879
2012	481	1257
2013	547	927

a computer every day just accomplishes its purpose as suggested by Malan (2011). Students' responses indicate that these OER videos are interesting and challenging. Videos with subtitles are highly proposed by those who are not English-native speakers. There are not so many courses with full English content in this medical university. At present, increasing numbers of international students elect this course due to its English-speaking content. Students obviously divide into groups of native students and international students and the two groups show opposite opinion on the language issue. In addition, the first version of video was in Flash video format and was not mobile-device friendly. These videos have been changed into MP4 format in 2014.

Students have shown the enhancement of self-regulated learning through Malan's OERs. Course activities appear to induce students to participate and view more. Teaching materials consisting of more operations and instructions have gained more views than just delivering knowledge content. Although, activities of the book club and Jeopardy-like game were not popular in this survey, they offered opportunities for students to cooperate with each other in the learning process. Few students left very encouraging massages in the forum and appraised the interactions appear in the online competition. During the period of 2008 to 2013, after summing up online documents and discussions produced by students through LMS records, the BCC course was considered to be one of the most "active" courses. The amount of each year is indicated in Table 3.

To manage the course, the instructor used to consume considerable amount of time to reply the students' message and setup the LMS content. Thanks to the efficient support of the LMS, many logistical issues can be resolved by this educational technology. However, to calculate peer review scores fairly is still a fairly challenging task. A better design LMS function to support instructor logistics may be needed. Overall, the BCC course in this study has been offered once per year in a medical university as a general education course for the past 10 years. In the beginning, this course was primarily a lecture-based format. Both the instructor and students were dissatisfied with either the content or the outcomes. After the introduction of innovative course activities, students tended to show positive response in course satisfaction, even though the new design requires considerably more time on assignments and studying. Recent surveys show that more than 90% of students who took the course reported they have learnt the BCC. In addition, more than 90% of students who took the

course recommend it to others. These perceptions are supported by the fact that the enrollment rate of this course has increased in recent years, and it has become one of the most popular courses in the university where this study was conducted.

Further research is recommended regarding relationships of student majors to outcomes in the BBC course. It is expected that students' performance will be different among majors in the health science field. Traditionally, medical students have higher entrance exam scores than other students of health-related majors and therefore may be expected to perform better. In this course, the result does support this expectation. However, further study may be needed regarding these findings and the details of relationships between student majors and BCC course outcomes.

Conclusion

Based on the findings of this study, innovative activity design appears to be an effective method to enhance computer literacy for undergraduate students with health science related majors. Utilization of educational technologies, such as LMS and OER, can benefit both instructors and students. Further research should be undertaken to validate and extend these findings, and to examine direct relationships between a computer literacy course and student academic performance, both in the BCC course itself and subsequently other academic work.

Conflict of Interests

The authors have not declared any conflict of interests.

Ethical approval

For this type of study, formal consent is not required at the university where this study was conducted.

REFERENCES

Abelson H (2008a). The Creation of OpenCourseWare at MIT. J. Science Educ. Technol. 17(2):164-174. doi: Doi 10.1007/S10956-007-9060-8

Abelson H (2008b). A Snapshot of Steps towards Change through Educational Technology. J. Sci. Educ. Technol. 17(2):208-210. doi:Doi 10.1007/S10956-008-9091-9

Adedokun OA, Liu J, Parker LC, Burgess W (2014). Meta-analytic Evaluation of a Virtual Field Trip to Connect Middle School Students with University Scientists. J. Sci. Educ. Technol. 24(1):91-102. doi:10.1007/s10956-014-9524-6

Atkins D, Brown J, Hammond A (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

Cassidy S (2011). Self-regulated learning in higher education: identifying key component processes. Stud. Higher Educ. 36(8):989-1000. doi:10.1080/03075079.2010.503269

DeVries I (2013). Evaluating Open Educational Resources: Lessons Learned. Procedia – Soc. Behav. Sci. 83:56-60. doi:10.1016/j.sbspro.2013.06.012

Graham CR, Woodfield W, Harrison JB (2013). A framework for institutional adoption and implementation of blended learning in higher education. Internet Higher Educ. 18:4-14. doi:10.1016/j.iheduc.2012.09.003

Hu E, Li Y, Li J, Huang WH (2015). Open educational resources (OER) usage and barriers: a study from Zhejiang University, China. Educ. Technol. Res. Dev. 63(6):957-974. doi:10.1007/s11423-015-9398-1

Junco R, Clem C (2015). Predicting course outcomes with digital textbook usage data. Internet Higher Educ. 27:54-63. doi:10.1016/j.iheduc.2015.06.001

Kovanović V, Gašević D, Joksimović S, Hatala M, Adesope O (2015). Analytics of communities of inquiry: Effects of learning technology use on cognitive presence in asynchronous online discussions. Internet Higher Educ. 27:74-89. doi:10.1016/j.iheduc.2015.06.002

Kuo YC, Walker AE, Schroder KEE, Belland BR (2014). Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. Internet Higher Educ. 20:35-50. doi:10.1016/j.iheduc.2013.10.001

Lee S, Kang E, Kim HB (2014). Exploring the Impact of Students' Learning Approach on Collaborative Group Modeling of Blood Circulation. J. Sci. Educ. Technol. 24(2-3):234-255. doi:10.1007/s10956-014-9509-5

Malan D (2011). Computer Science E-1: Understanding Computers and the Internet, Spring 2011. Retrieved from http://computerscience1.tv

Marcus-Quinn A, Diggins Y (2013). Open Educational Resources. Procedia – Soc. Behav. Sci. 93:243-246. doi:10.1016/j.sbspro.2013.09.183

McCabe DB, Meuter ML (2011). A Student View of Technology in the Classroom: Does It Enhance the Seven Principles of Good Practice in Undergraduate Education? J. Market. Educ. 33(2):149-159. doi:10.1177/0273475311410847

Murphy P, Wolfenden F (2013). Developing a pedagogy of mutuality in a capability approach: Teachers' experiences of using the Open Educational Resources (OER) of the teacher education in sub-Saharan Africa (TESSA) programme. Int. J. Educ. Dev. 33(3):263-271. doi:10.1016/j.ijedudev.2012.09.010

Nielsen W, Miller KA, Hoban G (2014). Science Teachers' Response to the Digital Education Revolution. J. Sci. Educ. Technol. doi:10.1007/s10956-014-9527-3

O'Dowd R (2013). Telecollaborative networks in university higher education: Overcoming barriers to integration. Internet Higher Educ. 18:47-53. doi:10.1016/j.iheduc.2013.02.001

Shelton BE, Duffin J, Wang Y, Ball J (2010). Linking open course wares and open education resources: creating an effective search and recommendation system. Procedia Comput. Sci. 1(2):2865-2870. doi:10.1016/j.procs.2010.08.012

Shen D, Cho MH, Tsai CL, Marra R (2013). Unpacking online learning experiences: Online learning self-efficacy and learning satisfaction. Internet Higher Educ. 19:10-17. doi:10.1016/j.iheduc.2013.04.001

Sikorski EG, Johnson TE, Ruscher PH (2011). Team Knowledge Sharing Intervention Effects on Team Shared Mental Models and Student Performance in an Undergraduate Science Course. J. Sci. Educ. Technol. 21(6):641-651. doi:10.1007/s10956-011-9353-9

Smolinski TG (2010). Computer literacy for life sciences: helping the digital-era biology undergraduates face today's research. CBE Life Sci. Educ. 9(3):357-363. doi:10.1187/cbe.10-03-0050

Tang Y, Jang Y, Wan H (2013). Building a middleware for heterogeneous OpenCourseware metadata systems. Paper presented at the AROOC2012, Bangkok, Tailand.

Vickrey T, Rosploch K, Rahmanian R, Pilarz M, Stains M (2015). Research-based implementation of peer instruction: a literature review. CBE Life Sci. Educ. 14(1):3. doi:10.1187/cbe.14-11-0198

Wolter BHK, Lundeberg MA, Bergland M, Klyczek K, Tosado R, Toro A, Dinitra White C (2012). Student Performance in a Multimedia Case-

Study Environ. J. Sci. Educ. Technol. 22(2):215-225. doi:10.1007/s10956-012-9387-7

Xie K, Yu C, Bradshaw AC (2014). Impacts of role assignment and participation in asynchronous discussions in college-level online classes. Internet Higher Educ. 20:10-19. doi:10.1016/j.iheduc.2013.09.003

Yue K, Chen P (2004). Open Courseware and Computer Science Education. Paper presented at the CCSC: Rocky Mountain Conference.

Yue K, W D (2004). Design and Evolution of An Undergraduate Course. Paper presented at the ITICSE'04, Leeds, United Kingdom.