Design and Realization of the E-learning Evaluation Based on TEST

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Abstract. Design and development of online evaluation system is the current hot research about the online learning evaluation, but the current implementation of the evaluation systems are mostly based on the given evaluation model to develop an experimental system or build a technology framework, which do not put into practice. The online learning is a complex system, in order to avoid e-learning implementation and development are disturbed by the negative factors, it is imminent that peoples establish a set evaluation system and quality management standard that are from planning to design, development, implementation, monitoring and evaluation. Try to give e-learning evaluation quota, on the basis of above establish online evaluation model and realize its system, the system is reliable and effective after the test.

Introduction

In the present information age, virtual learning, mobile learning, ubiquitous learning and so on are all relied on the continuous development and evolution of e-learning. About data show that in the last ten years, the number of online registered students in the world accounted for the proportion of higher education has more than 25% [1]. Massachusetts Institute of Technology Sloan business school survey data show that in 2010 the United States registered online learning college students than in 2009 more than one million [2]. Domestic aspects, by 2010, network education of the undergraduate and specialist online students had 4531000 people, year enrollment is the total number of college admissions 25% [3]. With the development of network technology and the arrival of the digital era, online learning will become the important way of learning in the future [4].

The e-learning needs some restraint mechanism and monitoring mechanism to guarantee the learning quality. Learning evaluation is an important way to realize the learning monitor, through the value judgment of students learning process and the results, it can study and promote the learning quality [5]. In the process collects objective datum, information and data of the e-learning process in the network environment to quantitatively analyze for learning attitude, behavior and results, and judge the e-learning quality, still exists some problems [6]: incomplete evaluation information, existing evaluation system is very difficult to record and monitor the e-learning effect; pay attention to the results and despise the learning process; evaluation subject is single; objectivity tests are too much; evaluation comprehensiveness is not high, for example, when separately evaluates for some factor of influence, how to consider other factors to learners' influence such as the learners' participation, assignments, discussions etc. In addition, narrowly understanding of the e-learning dynamic mechanism and simply treatment of the e-learning behavior are more prominent, design and development of the evaluation system focus on learning behavior monitor, at the same time it should be emphasized that learning motivation of the learners are excited [7]. In view of this situation, it is necessary to design effective learning process monitoring system by using the information technology [8].

E-learning Evaluation Quota

Research of online learning evaluation of the comprehensive evaluation total-evaluation method is based on the TEST, and evaluation subject is composed of teachers, engineers and students. The e-learning and classroom teaching parallel execution, it gets the total score of the course according to online learning evaluation and online test at the end of the term, by which generates course credits after the end of learning, and compares with MOOC have in common.

In the “state modern distance education resource construction technical specification”, it recommends that student evaluation system of the remote teaching system should include: student to choose learning content depth degree evaluation, student assignment evaluation, question answering evaluation for students, discussion evaluation, examination evaluation that is composed of test difficulty, test reliability and test score, and attitude evaluation. According to this, construct the evaluation quota of the online learning, the course content is one of the evaluation quotas to carry out evaluation in real time for learning process and content effect; with learning rate of progress automatically set test questions, after answer correction and continue to learn, and at the same time, after each learning modules is finished, require the grade of the corresponding thematic test is up to standard. Evaluation task quota, each task completes in three stages, and the corresponding there are learning evaluation of the three stages, the evaluation subject consists of engineers, teachers and students. The evaluation quota of the question answering, through the online message and learning forum to solve answering questions and discussion for learning difficulties, teachers help students, students can also. The discussion evaluation quota, the curriculum uses the theme activity and the forum replies to implement attitude evaluation of the student participation. Test quota, make the test system carry out result assessment to students, first the system establishes the checked test syllabus; secondly create question bank and check questions one by one including ownership of the examination point, rationality of the question difficulty, question scientificness etc; finally after defined test paper, check the coverage range of the examination points, the difficulty of the test paper etc. The quotas of the course document learning and the micro learning can improve the learning quality and solve effectively the problems of the practical application.

To achieve issues of the incomplete evaluation information and other issues of the end of assessment and format assessment, need make using of a variety of evaluation tools, a variety of evaluation subjects, a variety of learning dynamic excitation mechanism to evaluate the e-learning. Therefore, evaluation should include thematic test evaluation called E-TT for short, the task learning evaluation called E-TL, evaluation of document learning process call E-DLP, evaluation of course learning process called E-CLP, evaluation of micro course e-learning called E-ME, evaluation of activity theme called E-AT and evaluation of discussion and interaction called E-DI. In addition, discussion evaluation contains evaluation contents of incentive innovation.

Implementation Model of Evaluation

The online learning evaluation model based on TEST is implemented formula (1) and (2).

$$TEST_0 = E_{tt} + E_{tl} + E_{dlp} + E_{clp} + E_{me} + E_{at} + E_{di} \quad (1)$$

$$TEST = \begin{cases} Test_0, & Test_0 \leq 99 \\ 99, & Test_0 > 99 \end{cases} \quad (2)$$

Evaluation of Thematic Testing. The thematic test model T follows as formula (3). In formula (3), the thematic test of the No. I learning situation is composed of $f_{si}, f_{mi}, f_{ji}, f_{bi}, f_{ai}$, among them which f_{ai} can be an option, f_{si} is single choice function, f_{mi} is multiple choice function, f_{ji} is judgment function, f_{bi} is function of the fill in the blanks and f_{ai} is application function.

$$T = \{E_{ti} \mid E_{ti} \in \{f_{si}, f_{mi}, f_{ji}, f_{bi}, [f_{ai}]\}\}, i \in (1, 2, \dots, n) \quad (3)$$

Calculating grade method of the user's thematic test follows as formula (4). In formula (4), PPS_i is number I learning situation test points corresponding thematic test and its pass mark proportion, a learning situation test score = set fraction s_0 / total of the learning situation.

$$E_u = s_0 / \sum_{i=1}^m PPS_i \quad (4)$$

Task Learning Evaluation. In E-TL, students, teachers and engineers evaluate assignment by student submission after task completed. E-TL can support student upload works, schemes, comprehensive application document, the implementation of each task divided into three stages, evaluation rules can be defined according to different course, and then the score module of the document gives evaluation result. The demand model of the E-TL follows as formula (5). In formula (5), S_i, T_j, E_k respectively represent evaluation grade of the i student, the j teacher, the k engineer; P_1, P_2 and P_3 are the corresponding proportion coefficient; n, m and y respectively are the numbers of the student mutual, teachers evaluation, expert evaluation.

$$E_{tl} = \left[\left(\sum_{i=1}^n S_i \times P_1 \right) / n + \left(\sum_{j=1}^m T_j \times P_2 \right) / m + \left(\sum_{k=1}^y E_k \times P_3 \right) / y \right] \quad (5)$$

$$S_i = (s_1 + s_2 + s_3) / 3, T_i = (t_1 + t_2 + t_3) / 3, E_i = (e_1 + e_2 + e_3) / 3 \quad (6)$$

In formula (6), S_1, S_2 and S_3 represent any student's evaluation scores of the initial, middle and final three stages about task implementation process; T_i and E_i are similarly.

Evaluation of Document Learning Process. E-PD is any user's evaluation of the document learning process, learning technology document by evaluation criteria called EC , real-time monitor called RTM and document evaluation upper limit called $DEUL$ to evaluate. In addition, real-time generate questions according to itself, and then evaluate by answer data.

$$P_{tp} = \sum_{i=1}^n f(x_i) \times p_i, x_i \in [P|C|M], p_i \in [0,1] \quad (7)$$

In formula (7), P_{tp} represents real-time problems, test questions are generated by the current evaluation content to determine, namely $x_i \in [P|C|M]$; P stands for document evaluation problem sets, C represents the problem of curriculum evaluation set, M on behalf of micro course evaluation set. Therefore, we can obtain formula (8), (9), (10).

$$C = [C_1, C_2, \dots, C_j, C_m], M = [M_1, M_2, \dots, M_j, M_m], P = [P_1, P_2, \dots, P_j, P_m] \quad (8)$$

$$E_{pd} = \begin{cases} \sum_{i=1}^n EC_i \times RTM \times \sum_{i=1}^n f(x_i) \times p_i, EPD \leq DEUL, n \geq 5, RTM_i = R_0 / n \\ DEUL \times \sum_{i=1}^n f(x_i) \times p_i, EPD > DEUL \end{cases} \quad (9)$$

$$RTM_i = t \geq 0.6T_i ? 1 : 0 \quad (10)$$

Among them, P_0 is the total score of the E-PD, the EC_i and RTM_i are the evaluation scores and real-time monitoring parameters of document I. In formula (10), T_i represents time constant of user online learning document, learning time over 60% of the T_i can be identified for effective learning, and then there is $T_i \in \{T_1, T_2, \dots, T_n\}$.

E-CLP and E-ME. The process evaluation of course learning of any user's learning situation called PEC , which is consisted of segmented evaluation called SE , course real-time monitoring called $CRTM$ and course evaluation upper limit called $CEUL$. We can obtain formula (11), (12).

$$E_{clp} = \begin{cases} \sum_{i=1}^n f(x_i) \times p_i \times SE_i \times CRTM, PEC < CEUL \\ CEUL \times \sum_{i=1}^n f(x_i) \times p_i, PEC \geq CEUL \end{cases} \quad (11)$$

$$CRTM_i = t \geq 0.6T_i ? 1 : 0 \quad (12)$$

In formula (12), T_i represents time constant of user online learning courseware, learning time over 60% of the T_i can be identified for effective learning, and then there is $T_i \in \{T_1, T_2, \dots, T_n\}$. E-ME is divided into the project micro course called PM and curriculum micro course called M, so that more consistent with the combination of theory and practice. The calculation method of evaluation follows as formula (13).

$$E_{me} = \sum_{i=1}^n PM_i \cdot score \times f(x_i) \times p_i \cdot \frac{t}{T_i} + \sum_{j=1}^m M_j \cdot score \times f(x_j) \times p_j \cdot \frac{t}{T_j} \quad (13)$$

In formula (13), PM_i and M_j respectively represent project micro course i and curriculum micro course j , and respectively represent PM_i and M_j corresponding to the learning time, and t is learning micro course time.

E-AT and E-DI. The definition of the E-AT is followed as formula (14):

$$E_{at} = \sum_{i=1}^n AT_i = \sum_{i=1}^n at_i \cdot score \quad (14)$$

In formula (14), AT_i is the activity evaluation result, and the activity number is set according to need. The evaluation score of activity I is represented as $at_i \cdot score$. The definition of any user performed the E-DI is followed as formula (15):

$$E_{di} = \left[\sum_{i=1}^n DI_i + \sum_{j=1}^m p(x_j) \cdot value \right] \times 40 \quad (15)$$

In formula (15), DI_i is the discussion evaluation result, and the activity number is set according to need. The evaluation reference score of discussion I is 0.5 score; represents the evaluation result of added post j , further expressed $p(x) \cdot value \in [10, 5, 3]$. D_0 is three incentive points, so $D_0 \in [10, 5, 3]$, namely when the students add innovative learning content and has a detailed diagram, $p(x) \cdot value = 10$; after participate in discussion and post, and if be approval, $p(x) \cdot value = 5$; if active positive post and post click rate more than 50 times, $p(x) \cdot value = 3$. When $p(x) \cdot mark = \text{true}$, $p(x) \cdot value = 10$; when $p(x) \cdot confirm = \text{true}$, $p(x) \cdot value = 5$; when $p(x) \cdot count \geq 50$, $p(x) \cdot value = 3$.

Implementation and Test Analysis

System Implementation. In pseudo code of the algorithm, ett represents the thematic evaluation, etl represents the task evaluation, epd represents evaluation of document learning process, eclp represents evaluation of course learning process, ems represents evaluation of micro course, eat represents activity evaluation, and edi represents a parameter of the discussion evaluation. The algorithm described in detail as following.

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while (user.login==true)
    if (ett==true) according to formula (3) generate thematic questions; test monitoring || client
    implementation. After test finished, record unit test scores; according to formula (4) compute score
    and save into database; end if
    if (etl==true) submit task implementation reports; student mutual assessment, teacher evaluation,
    engi-neering evaluation; use formula (6) to compute results of each task evaluation; use formula (5)
    to calculate the task evaluation of a student; end if
    if(epd==true) learn document, record monitoring status; calculate values of the  $EC_i \times RTM_i$  and
    formula (10); record scores have learned; use formula (7),(8) and (9) to compute scores of the
    document learning evaluation; end if
    if(eclp==true) learn courseware, record monitoring status; compute values according to  $CEC_i \times$ 
 $CRTM_i$  and formula (12); record scores have learned course-ware; use formula (7) ,(8) and (11) to
    calculate scores of the courseware learning evaluation; end if

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if(ems==true)learn project micro course || curriculum micro course; $PM_i.score \times t \div T_i$ || $M_i.score \times t \div T_i$, compute project || micro course scores, and record; use (7), (8) and (13) to count scores of the micro course learning evaluation; end if

if (eat==true) participate in the theme activities; record the theme activities; use formula (14) to calculate scores of subject activity evaluation; if end

if (edi==true)discuss or reply topic; record reply situation; send post; calculate $p(x).value$ according to formula (15);record post evaluation results; count discussion evaluation results; if end.

Use formula (1) and (2) to gather statistics user online learning evaluation scores.

Test and Analyze. Test mainly tests student's various learning behavior feedback. The evaluation set of the test course is: 8 chapter course wares, score 16, and each chapter evaluation threshold 30 minutes and 20 questions. This code is E-courseware; (2) articles of the course and knowledge has 84 papers, article threshold 5, 15 questions per paper, this code: E-article; (3) the E-TT, eight learning units, scores 16 points, this code: E-test; (4) the E-TL , four learning tasks, 9 points per task, After finished the stage of each task obtaining 3 points, the code: E-task; (5) the E-ME,3 project micro courses , setting 3 points, 30 minutes pre micro video. 6 course micro courses, setting 6 points, 10 minutes per video. Per video are 10 questions. The code: E-micro-course; (6) the E-AT, 37 activities, 0.5 points per activity, the code: E-activity; (7) the E-DI, 0.1 points per reply, the code: E-discussion. Test and analyze with learning behavior of Joe students, Joe's E-courseware results are shown as Table 1. His E-article shows as Table 2.Joe has completed thematic test of 8 units, the E-test evaluation results are shown as Table 3; his E-task valuation results are shown as Table 4. Machine evaluation and artificial evaluation exists a slight error is mainly that sys-tem calculates third decimal place doesn't have four to five homes, but after rounding results don't affect; his E-micro-course results are shown as Table 5. Joe's activities are 8 times, evaluation of artificial and machine both are 4 points; the data of discussion evaluation: reply and confirmation 1,1 post and click number more than 50, 24 times reply , both evaluation are 10 points. Through the analysis of the above instance data, the results of Joe's learning evaluation are both consistent analysis by artificial and machine means. So the results of the system are reliable and effective.

Table 1. Evaluation Data of Joe's e-courseware

Evaluation project	Time threshold	Effective time	Question threshold	Answer correct number	Machine scores	Artificial scores
C-No1	30 mins	21 mins	20	20	0 points	0 points
C-No2	30 mins	34 mins	20	20	2 points	2 points
C-No3	30 mins	50 mins	20	20	2 points	2 points
C-No4	30 mins	72 mins	20	18	0 points	0 points
C-No5	30 mins	66 mins	20	20	2 points	2 points
C-No6	30 mins	55 mins	20	20	2 points	2 points
C-No7	30 mins	70 mins	20	20	2 points	2 points
C-No8	30 mins	98 mins	20	20	2 points	2 points
Subtotal					12 points	12 points

Table 2. Evaluation Data of Joe's E-article

Evaluation project	Question threshold	Evaluation threshold	Effective time	Click number	Correct number	Machine scores	Artificial scores
A-No23	15	25 mins, interval 2 mins, clicks $\geq$ 8	38 mins	145 times	15	0 points	0 points
A-No27	15	25 mins, interval 2 mins, clicks $\geq$ 8	53 mins	213 times	15	2 points	2 points
A-No45	15	25 mins, interval 2 mins, clicks $\geq$ 8	41mins	109 times	15	2 points	2 points
A-No78	15	25 mins, interval 2 mins, clicks $\geq$ 8	34 mins	172 times	10	0 points	0 points
A-No12	15	25 mins, interval 2 mins, clicks $\geq$ 8	27 mins	61 times	15	2 points	2 points

Table 3. Evaluation data of Joe's E-test

Evaluation project	Total score	Evaluation threshold	Actual score	Machine scores	Artificial scores
T-No1	100 points	60%	54 points	0 points	0 points
T-No2	100 points	60%	81 points	2 points	2 points
T-No3	100 points	60%	77 points	2 points	2 points
T-No4	100 points	60%	84 points	2 points	2 points
T-No5	100 points	60%	73 points	2 points	2 points
T-No6	100 points	60%	95 points	2 points	2 points
T-No7	100 points	60%	47 points	0 points	0 points
T-No8	100 points	60%	77 points	2 points	2 points

Table 4. Evaluation data of Joe's E-task

Project	Time threshold	Effective time	Question threshold	Correct number	Machine scores	Artificial scores
C-No1	30 mins	21 mins	20	20	0 points	0 points
C-No2	30 mins	34 mins	20	20	2 points	2 points
C-No3	30 mins	50 mins	20	20	2 points	2 points
C-No4	30 mins	72 mins	20	18	0 points	0 points
C-No5	30 mins	66 mins	20	20	2 points	2 points
C-No6	30 mins	55 mins	20	20	2 points	2 points
C-No7	30 mins	70 mins	20	20	2 points	2 points
C-No8	30 mins	98 mins	20	20	2 points	2 points

Table 5. Evaluation data of Joe's E-micro-course

Evaluation project	Student evaluation		Teacher evaluation		Engineer evaluation		Machine scores	Artificial scores
	scores	Student number	scores	Teacher number	scores	Engineer number		
T-No1	63	29	11	4	6	3	2.3	2.31
	53	20	8	3	5	2	2.57	2.61
	67	26	11	4	7	3	2.55	2.55
T-No2	90	30	9	4	5	3	2.3	2.34
	69	23	8	3	7	3	2.66	2.67
	90	30	9	3	8	3	2.88	2.89
T-No3	90	30	7	3	6	3	2.44	2.44
	90	30	7	3	7	3	2.55	2.55
	90	30	8	3	7	3	2.66	2.67
T-No4	90	30	9	4	7	3	2.52	2.53
	90	30	10	4	5	3	2.38	2.39
	90	30	5	2	8	3	2.72	2.72

Summary

By research about connotation principles and tools of the e-learning evaluation, give the evaluation quotas, based on this to set evaluation model, and use the model to have developed the system and evaluation of the effective was verified. Although the evaluation quotas are reasonable, but quota thresholds also need to further promote and verify, so as to be a reasonable reference for evaluation thresholds.

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