An Evaluation of the Implementation of Instructional Design Skill Standards for E-Learning in Taiwan

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Abstract: - This study evaluated the implementation of an instructional design competency framework for e-learning in Taiwan. The item difficulty indexes and item discrimination indexes of the certification examinations on instructional design core competency for e-learning showed that the test items were adequately designed. According to the analysis on types of test item and knowledge levels of test item, the examinees performed equally in responding to the single-answer items and to the multiple-answer items; accordingly, the examinees performed equally on the application items and the comprehension items. In the past two years of implementation of the e-learning skill certification, 79 examinees took the instructional design for e-learning certification examinations, and only 11 of them had passed the e-ID core knowledge examination. The low passing rate suggested that effective promotion strategies and diffusion of information concerning e-learning skill standards and certification to the prospective participants should be further enforced in order to reach the goal of making the skill standards serve as a common framework for educational institutions, practitioners and researchers in the e-learning related fields.

Key-Words: - e-learning, instructional design, IT skill standards

1 Introduction

Information technology (IT) skill standards are a clear and systematic set of proficiency indicators for the types of skills needed by companies offering IT-related services. It defines the professional knowledge, skills, and abilities required to succeed in today's digital workplace. IT skill standards can serve as a common framework for educators, industry, and other stakeholders to develop educational and training tools and programs to prepare students and workers to resolve workplace challenges [1][2][3][4][5].

The development of IT skill standards in Taiwan started in 2001 based on the results of APEC Ministerial Meeting in 2000. The framework of Taiwanese IT Skill Standards, Information Technology Expert (ITE), referred to the frameworks of NWCET (the National Workforce Center for Emerging Technologies, USA) and METI (the Ministry of Economy Trade and Industry, Japan), and contains 4 components, including "major tasks", "skill criteria", "knowledge structure", and "certification subjects", to define a specific area of specialization. In the present time, 10 categories of ITE certifications are provided by the Computer Skills Foundation (CSF), including Management of Information Application, Network Communication, Project Management, System Analysis, Software Design, Information Secure, Lodge in System, Database Application, Digital Learning, and Digital Content. There are 44 examination subjects provided by CSF quarterly totally.

2 The development of e-ID skill standards

For responding to the rapid growth of e-learning related industries in Taiwan, a competency framework of instructional design for e-learning was established by the Industry Bureau of the Ministry of Economic Affairs in 2005 through a series of expert panels, practitioner panels, and focus groups [7]. The Instructional Design Skill Standards for E-Learning intended to define the general and core competency of an e-learning instructional designer (e-ID). The e-ID Skill Standards can serve as a guideline to help e-learning service providers to hire qualified employees, measure employees' capabilities against

the skill standards, and provide train programs to fulfill employees' capabilities. For education and training organizations, the e-ID Skill Standards can provide an objective basis for the design of training programs.

The e-ID Skill Standards were developed through a procedure of defining the major tasks of e-ID, conducting e-ID task analysis, analyzing e-ID performance indicators, analyzing prerequisite knowledge and skills, defining e-ID knowledge structure, and defining e-ID certification subjects. Annual evaluation was conducted against the compliance of the e-ID Skill Standards and possible revision suggestions were discussed through the annual committee meeting. The framework of the e-ID Skill Standards follow the ITE framework and contain 4 components, including "major tasks", "skill criteria", "knowledge structure", and "certification subjects", in defining the e-ID profession. The framework of e-ID Skill Standards is introduced as follows.

2.1 The major tasks of e-ID

According to the tasks conducted by an e-ID, the major tasks can be described as the ADDIE sequence of "Analyzing training needs", "Designing course and instructional material", "Developing instructional material", and "Implementation and Evaluation". The major tasks of e-ID and sub-tasks for each major task are identified and shown as Table 1.

2.2 The skill criteria of e-ID tasks

The skill criteria are measurable performance indicators linked to certain knowledge or skills conducted by an e-ID during the e-learning development process. For example, there are two performance criteria in the sub-task of "1-1 Analyzing training needs", a. being able to judge the performance gaps from the results of the gap analysis on the target audience and the organization's training goals, and b. being able to identify training needs and objectives, and plan a training program.

2.3 The knowledge structure of e-ID

The knowledge structure describes the general knowledge and the core knowledge required by an e-ID and is especially useful for planning education and training programs to cultivate competent e-ID. The knowledge structure of e-ID Skill Standards contains three levels of knowledge. For instance, the first two levels of core knowledge are described just like the major tasks and sub-tasks shown in Table 2. Then the third level of core knowledge is elaborated for each second level core knowledge. In spite of the "Analysis", "Design", "Development", "Implementation and Evaluation" core knowledge, the knowledge structure of e-ID Skill Standards contains an additional knowledge category of "the development of e-learning courseware project" in order to integrate and practice the ADDIE core knowledge in the hands-on e-learning courseware development.

2.4 The examination subjects of e-ID

The examination subjects were designed to cover the general knowledge and the core knowledge described in the knowledge structure of e-ID in order to accurately assess an examinee's proficiency level. There are two subjects designed for assessing e-ID competency, including "Introduction to e-learning" and "Instructional design for e-learning". "Introduction to e-learning" assesses an examinee's general knowledge of e-learning. Accordingly, "Instructional design for e-learning" assesses an examinee's core knowledge of instructional design for e-learning. An examinee will be certified with the e-ID certificate if he passes both the general knowledge subject and the core knowledge subject.

3 The status quo of e-ID certification

The test item design principles and profile of "Instructional design for e-learning" examination are shown in Table 2. The total score of an examination subject is 100, cut-point is 70, and the expected passing rate is 20%. The test items are designed to follow the principles of (a) item difficulty: difficulty: medium: easy = 1□2□1, (b) multiple choice test item ratio: single-answer vs. multiple-answer = 4□1, and (c) multiple choice test items 60% (30 items) and case design 40%. Up to date, six "Instruction design for e-learning" examinations have been offered by CSF since the e-ID Skill Standards were implemented in April 2005. There were 79 examinees taking the e-ID core knowledge examinations, and only 11 (13.9%) had passed.

Table 1 e-ID major tasks and core competency

Major task	Task description
1. Analyzing training needs	1-1 Analyzing training needs 1-2 Analyzing target audience 1-3 Analyzing the content 1-4 Analyzing the learning environment
2. Designing course and instructional material	2-1 Planning the mode of e-learning 2-2 Designing course content 2-3 Developing course objectives, test items, and instructional methods 2-4 Developing instructional strategies 2-5 Planning and designing e-activities
3. Developing instructional material	3-1 Designing the learning interface 3-2 Designing storyboard 3-3 Planning learning resources 3-4 Integrating course material and learning resources
4. Implementation and Evaluation	4-1 Assisting the implementation of e-learning activities 4-2 Conducting formative evaluation 4-3 Conducting summative evaluation

Table 2 Principles of test item design for e-ID certification examination

Aspect	Principle or Criterion
Total score	100 points
Cut-point	70 points
Passing rate	20%
Difficulty arrangement	difficult: medium: easy = 1:2:1
Item knowledge levels	Comprehension vs. Application
Types of items	Multiple-choice and Case design
Ratio of multiple choice items	Single-answer: multiple-answer = 4:1

Table 3 Item type, average rate of correctness, and SD of test items by e-ID core knowledge category

Knowledge category	Item type	Number of items	Item ratio	Avg. rate of Correctness	SD
1. Training needs analysis	Multiple choice	5.0	17%	0.4269	0.3160
2. Course and instructional material design	Multiple choice	10.0	33%	0.4177	0.2564
3. Instructional material development	Multiple choice	10.3	34%	0.5246	0.3144
4. Implementation and Evaluation	Multiple choice	4.7	16%	0.4171	0.3027
5. Case design (Application)	Case design	3.0	40%	0.3734	0.2533
Total		33	100%	0.4320	0.2886

Note. N = 79

4 Methods and Results

In this study, the profile of test items was analyzed by knowledge category, followed by the analysis of item difficulty and item discrimination indexes. Then, ANOVAs were conducted to examine the effects of knowledge level (comprehension vs. application), type of item (single-answer vs. multiple-answer) and presumed difficulty (easy, medium, difficult) on examinees' performance (average rates of correctness).

4.1 Profile of the test items of e-ID examinations

The type of test items, number of test items, weight, average rate of correctness, and standard deviation of the e-ID core knowledge examinations divided by

knowledge categories are shown in Table 3. The average rates of correctness on multiple choice test items for each core knowledge category ranged from 54.61% to 68.98%. The overall rate of correctness on the examinations was 53.96%. Although the average rates of correctness on multiple choice test items are acceptable, the overall rate of correctness on the examinations, however, is far below the cut-point of 70 points. This indicated that the test items, especially the case design items, of e-ID core knowledge examinations were difficult. Therefore, only 11 out of the 79 examinees had passed the 70-point cut-point.

4.2 Difficulty and discrimination indexes analysis

The top 27% and the lowest 27% examinees of the e-ID core knowledge examinations were extracted as the hi-scored group and the low-scored group, respectively, followed by the calculation of the average rates of correctness for each core knowledge category for the hi-scored group and the low-scored group, respectively. Later, for analyzing the overall difficulty and discrimination indexes across examinations, average difficulty indexes and discrimination indexes for each core knowledge category were calculated. Finally, independent sample t-tests were conducted to examine whether the discrimination indexes were significant.

As shown in Table 4, the difficulty indexes for all knowledge categories ranged from .41 to .54. For a cut-point of .70 (70 points out of 100 points), the average difficulty indexes are relatively low (difficult), especially for the knowledge category of "case design". The effect of high difficulty was reflected on the low passing-rate (12.9%) of the core knowledge examinations. Among the 5 categories of knowledge, 4 of them had significant discrimination indexes. The results indicated that the test items for each knowledge category were able to distinguish competent and incompetent examinees except for the first knowledge category, "training needs analysis". Among the significant discrimination indexes, the knowledge category of "case design" which assessed an examinee's practical e-ID skills through hands-on case design showed the highest discrimination index (.52). This result indicated that "case design" is the best way for distinguishing competent e-ID core competency.

4.3 Analysis on average rates of correctness

The effects of knowledge level, type of test item and presumed difficulty of test items on examinees' performance measured by average rates of correctness on each test item were examined by means of ANOVAs. The result of Levene's test of equality on examinees' average rates of correctness for the 90 multiple-choice test items of the 3 e-ID core knowledge examinations was not significant, $F_{(11, 108)} = 1.353$, $p = .213$. The null hypothesis that the error variance of the dependent variable is equal across groups was accepted. In other words, the examinees' average rates of correctness on test items were equal across groups, and ANOVAs were proceeded. The average rate of correctness, standard deviation, and number of items for groups of knowledge level (comprehension vs. application), item type (single-answer vs. multiple-answer) and presumed difficulty (easy, medium, difficult) are shown in Table 5.

The ANOVA summary of knowledge level, type of test item and presumed difficulty of test items on average rates of correctness is shown in Table 6. The main effects of knowledge level, type of test item and presumed difficulty were not significant. In other words, there was no significant difference between groups. This also indicated that the examinees performed equally no matter the test item's knowledge level is "comprehension" or "application", the type of item is "single-answer" or "multiple-answer" multiple choice, or the presumed difficulty is "easy", "medium", or "difficult". The non-significant result of item type indicated that examinees performed equally while responding to the different presumed difficulty items, the single-answer test items, and the multiple-answer items. Therefore, it can be concluded that the presumed difficulty of test items was not as it was designed for those examinees. It also indicated that the type of item stood a neutral position in delivering the test items to the examinees through the e-testing interface. Therefore, the examinees could performed equally well in responding to both the single-answer items and the multiple-answer items. Accordingly, the non-significant results of knowledge level, however, might indicate that the application-level test items provided more contextualized content to help the examinees better understand the meaning of the test items. Therefore, the examinees could perform the application-level test items as well as the easier comprehension-level test items.

Table 4 Summary of item difficulty and item discrimination analysis

Knowledge category	Hi-scored group's Avg. rate of Correctness	Low-scored group's Avg. rate of Correctness	Difficulty (P)	Discrimination (D)	t	Sig.
1. Training needs analysis	0.58	0.42	0.50	0.16	1.525	.137
2. Course and instructional material design	0.57	0.33	0.45	0.24	2.960	.006*
3. Instructional material development	0.69	0.39	0.54	0.30	3.205	.003*
4. Implementation and Evaluation	0.58	0.34	0.46	0.24	2.605	.014*
5. Case design	0.67	0.15	0.41	0.52	8.954	.000*

Note. Hi-scored N=21, Low-scored N=21, * p<.05

Table 5 Group means of average rates of correctness, SD, and number of items

Dependent variable	Group	Avg. rate of correctness	SD	Number of items
Knowledge level	Comprehension	.5542	.2640	39
	Application	.6091	.1796	51
Type of item	Single-answer	.5794	.2438	52
	Multiple-answers	.5933	.1870	38
Presumed difficulty	Easy	.6048	.2305	28
	Medium	.5709	.2282	50
	Difficult	.5996	.1701	12

Note. Total test items = 120

Table 6 ANOVA summary of knowledge level, type of item, and presumed difficulty on rates of correctness

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Knowledge level	0.072	1	0.072	1.452	.232
Type of item	0.002	1	0.002	.048	.828
Presumed difficulty	0.343	2	0.017	.345	.709
Error	4.227	115	0.497		

5 Conclusion and Discussion

The major findings drawn upon the results of this study can be further discussed as follows. First, the development of the e-ID Skill Standards employed a systematic process to define the general and core competency of instructional designers for e-learning through a series of expert and practitioner panels. Thus, the reliability and validity of the e-ID competency framework were ensured. The framework also provides opportunities for possible revisions to be examined through annual assessment in order to improve the quality and compliance of the framework. According to the discrimination indexes on e-ID knowledge categories, the test items of 4 out of 5 knowledge categories of the certification examinations were able to distinguish competent examinees from incompetent examinees. Therefore, it can be concluded that the e-ID Skill Standards and the certification examinations were adequately designed and implemented.

Secondly, the development of the e-ID Skill Standards intended to serve as a guideline to help e-learning service providers to hire qualified employees, measure employees' capabilities against the Skill Standards, and provide training programs to fulfill employees' e-ID capabilities. The e-ID Skill Standards were implemented in April 2005, however, only 8 out of the 62 examinees had passed the e-ID core competency examinations. The passing-rate of the e-ID core competency examinations (12.9%) was

much lower than the expected passing-rate (20%). The analysis on difficulty indexes revealed that the difficulty indexes for the knowledge categories of the examinations were much lower (difficult) than the .70 cut-point, especially the "case design" knowledge. The "case design" knowledge possessed the highest discrimination index as well as the lowest difficulty index (the most difficult). This seemed to indicate that the knowledge examined in the e-ID examinations targeted on the more advanced professionals instead of the entry-level professionals. The baseline perspective of e-ID Skill Standards was not clearly defined concerning the targeted examinees. From the results of the implemented examinations, the e-ID Skill Standards and certification examinations seem not to provide substantial help in assisting e-learning service providers to hire qualified employees nor measuring employees' e-ID competency yet.

Thirdly, if the e-ID core competency examinations were not too difficult, there must be the examinees not possessing adequate ID skills for developing e-learning courseware projects. Based on this hypothesis, the subsequent questions comes up, "why the competent prospective examinees did not take the e-ID examinations", "whether they already possessed a certain degree that can help them to get the e-ID jobs, so they do not have to take the e-ID certification examinations". Those subsequent questions drawn on the adequate difficulty hypothesis were not answered in the present study. Future studies are suggested to explore the related issues in details.

In conclusion, the initiative efforts of implementing the e-ID Skill Standards and certification has provided an objective basis for the design of education and training programs to prepare students and workers equipped with professional knowledge, skills, and abilities required to resolve instructional design challenges in today's digital workplace. Although the e-ID Skills Standards and certification have been adequate designed and implemented, further studies and efforts are needed in order to make the e-ID Skills Standards serve as a common framework for educational institutions, practitioners, and researchers and truly benefit all the participants in the field of e-learning.

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References:

[1] National Workforce Centers for Emerging Technologies. (2003). *Building a foundation for tomorrow: Skill standards for information technology (3rd Ed.)*. Bellevue, WA: Author.

[2] National Workforce Centers for Emerging Technologies. (1999). *Building a foundation for tomorrow: Skill standards for information technology*. Bellevue, WA: Author.

[3] Evans, N. (2002). Information technology jobs and skill standards. In B. L. Hawkins, J. A. Rudy, and W. H. Wallace, Jr. (Editors), *Technology everywhere: A campus agenda for educating and managing workers in the digital age*, pp. 25-38, Jossey-Bass.

[4] Randall, M. H. & Zirkle, C. J. (2005). Information technology student-based certification in formal education settings: Who benefits and what is needed. *Journal of Information Technology Education, 4*, 287-306.

[5] METI (2002). *Formulation of the IT skills standards (Ver. 1.0)*. Retrieved April 10, 2006 from http://www.meti.go.jp/english/information/downloadfiles/cITskille.pdf.

[6] Computer Skills Foundation (2006). *ITE skill standards and certification*. Retrieved on March 15, 2006 from http://www.itest.org.tw/.

[7] Ministry of Economic Affairs (2005). *Instructional design skill standards for e-learning*. Retrieved on March 15, 2006 from http://www.itest.org.tw/2005/PDF/e-2.pdf.