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A Study of Curriculum Design of Cable-TV to Promote College-Level Students' Practical Competencies

Liang-Te CHANG
De Lin Institute of Technology, Ching-Yun Rd., Tu-Cheng City, Taipei County, Taiwan,
c8804@ms57.hinet.net, http://www.dlit.edu.tw/

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ABSTRACT：*The main purpose of the study was to carefully investigate the entry-level cable TV competencies of those technicians and engineers graduated from junior colleges and colleges of technology, and developed required technical curricula. There were document investigations, field visit, and revised DACUM and questionnaire survey employed in the study process. The study confirmed the duties(items) and tasks(sub-items) of the cable TV technicians and engineers graduated from electronic programs of junior college and colleges of technology, and further advanced to analyze frequency and importance of above duty/task technical competencies. The contributions of the study will provide some important resources for curriculum development and practical instruction of cable TV technicians and engineers.*

1 INTRODUCTION

People with talents in industrial technology have been the principal driving force of our national economic developments. Starting with labor-intensive industries in early days, the economics have adjusted to the technique-intensive, capital-intensive aspects, and finally evolved to the current knowledge intensive industry. Having constantly progressed in accordance with the features and requirements of industrial development, technological and vocational education plays a crucial role in enriching human resources [1-2]. Technological and vocational education includes three-tiered institutions such as vocational schools, technical institutes, and technology universities. With the current impact of knowledge economics, it is an eminent mission to enhance the education quality, which is particularly required to cultivate a new generation of talents that can strive in the new era [3].

Cable Television (CATV) originated in the U.S., with an initial purpose of compensating poor local signal reception. It utilized a public antenna combined with generic amplifiers to amplify weak TV signals and transmit them to individual home receivers. At present, CATV has become a service that incorporates signals in audio, visual, text, and image formats on the server end and transmits them via optical fibers and/or coaxial cables to its subscribers. The entire system, which looks seemingly simple, essentially consists of the program source, server end, transmission networks, and the subscriber end. However, it demands close attention and poses potential risk in the choice of serve end equipment, arrangement, management, testing of system channels, designing, planning, realization, and maintenance of the transmission network, and development of subscriber end equipment. Given that the current industry is short of capability of system integration, it becomes necessary to prepare people in this particular area [4-6]. With the fast growth of CATV, it is worth more discussions on how to cultivate excellent professionals in industrial engineering and on exploring the future need of communication techniques in technology and vocational schools.

2 PURPOSES

From an industrial perspective, this study focuses on the technical competencies that the graduates of technology and vocational institutes need to work in the CATV industry. The result of this study is intended to serve as an instruction and reference of curriculum design and teaching

implementation for these institutes, in order to effectively cultivate or train people with practical talents in engineering that meet the industrial requirements. In practice, there are two main purposes:

(1) To develop the technical competencies in CATV engineering that graduates with electronics majors from technology and vocational institutes should have.
(2) To analyze the technical competencies in CATV engineering that graduates with electronics majors from technology and vocational institutes should have.

3 METHODS

(1) Literature review
Explore and analyze all the domestic and international studies, journal papers, and reports that discuss about the theory and implementation of curriculum development of technological and vocational education, and the professional curricula. The result obtained accordingly will be the foundation of this study.

(2) Document analysis
From these institutes, collect information on CATV such as books, magazines, lab materials, conference proceedings, and CATV training materials and conduct analysis and comparison, followed by summarization and conclusion, to generate bases on which sequential on-site interviews and questionnaire are to be developed.

(3) On-site interview
To further understand exactly what the technical abilities of graduates from institutes of various levels should be. This study selects the divisions of engineering techniques in five CATV companies in the greater Taipei region to conduct on-site interviews. In addition, combined with the result from documentation analysis, a "List of technical abilities required of CATV technical personnel in technology and vocational institutes from various levels" is drafted.

(4) Modified DACUM conference
Adopt modified DACUM method to identify the duty and task in the technical abilities required of the above CATV technical personnel. This conference should invite professional CATV engineers as the main attendants to conduct a capability analysis.

(5) Questionnaire survey
There are ninety-five CATV system providers that are registered and recognized by the Department of Broadcasting Affairs of Government Information Office, Executive Yuan. This study conducts questionnaire surveys on their divisions of engineering techniques by first calling them to see if they are willing to participate in this survey. With their consent, three copies of the questionnaire are mailed to their director, engineer, and technician in order to gather opinions of people from various levels for qualitative and quantitative .data

4 RESULTS

Through qualitative and quantitative measures such as literature review, document analysis, on-site interviews, modified DACUM conference, and questionnaire surveys, in the career technical competencies required of graduates with electronics majors from technology and vocational institutes, this study has summarized in seven aspects with a total of sixty-four items as follows: A. Select electronic components (with ten items), B. Use tools and equipment(with thirteen items), C. Install and Maintain CATV network (with eight items), D. Install signal transmission equipment (with nine items), E. Execute signal quality measurement (with eight items), F. Operate application software(with six items), and G. Dispose of emergencies and contingencies (with ten items). Table 1 lists Technical competency items and sub-items, Frequency, Importance, and Rank in CATV required for graduates of technical institutes, and Table 2 lists Technical competencies, levels, and suggested curricula in CATV

required for graduates of technical institutes.

There are five levels for the CATV technical competencies according to this study: Level 1: capable of executing assigned tasks with constant assistance by supervisor or administrator. Level 2: Able to execute assigned tasks with occasional assistance by supervisor or administrator. Level 3: Able to execute assigned tasks without any assistance by supervisor or administrator. Level 4: Capable of faster or better accomplishments than normal workers. Level 5: Successfully execute assigned tasks and capable of taking advantage of and adapting to new changes.

5 CONCLUSIONS

(1) Obtain the detailed list of the CATV technical competencies required of graduates with electronics majors from technology and vocational institutes.
(2) Obtain CATV technical levels for graduates with electronics majors from technology and vocational institutes.
(3) Acquire the corresponding curricula in CATV engineering for graduates with electronics majors from technology and vocational institutes.
(4) The above can be a reference for electronics departments of the technical institutes in the design of fundamental curriculum.6

6 TABLES

Table 1 Competency items, Frequency, Importance, and Rank in CATV required for graduates

Competency items	Frequency		Importance		Both	Rank
	AVG1	STD1	AVG2	STD2	AVG	
A. Select electronic components						
A-1 Choose transmission cable	4.410	1.058	4.255	0.985	4.333	1
A-2 Choose connector	4.410	1.023	4.164	1.067	4.287	2
A-3 Choose splitter	4.017	1.070	4.091	1.041	4.054	3
A-4 Choose network amplifier	3.804	1.086	4.255	0.985	4.030	4
A-5 Choose equalizer cable	3.357	1.197	3.836	1.167	3.597	8
A-6 Choose plug-in attenuator	3.411	1.058	3.927	1.086	3.669	7
A-7 Choose distributor	3.732	1.136	4.000	1.036	3.866	5
A-8 Choose directional coupler	3.500	1.128	3.873	1.123	3.687	6
A-9 Choose power interrupter	2.946	1.135	3.600	1.299	3.273	10
A-10 Choose DC/AC power supply	3.143	1.052	3.927	1.034	3.555	9
B. Use tools and equipment						
B-1 Use hand tools	4.946	0.227	4.455	0.878	4.701	2
B-2 Use power tools	3.821	0.974	3.564	1.167	3.693	4
B-3 Use dB meter	4.857	0.401	4.673	0.721	4.765	1
B-4 Use radio-frequency signal scan analyzer	3.232	1.191	3.618	1.178	3.425	6
B-5 Use system scan emitter	2.875	1.161	3.473	1.245	3.174	8
B-6 Use system scan receiver	2.821	1.130	3.418	1.301	3.120	9
B-7 Use network analyzer	2.696	1.143	3.309	1.230	3.003	10

B-8 Use TV test signal generator	2.536	1.348	2.927	1.303	2.732	11
B-9 Use waveform monitor	2.518	1.362	2.891	1.343	2.705	12
B-10 Use visual/base frequency signal general analyzer	2.375	1.273	2.873	1.320	2.624	13
B-11 Use electric wave sensor	2.964	0.972	3.618	1.130	3.291	7
B-12 Use spectrum analyzer	3.375	1.214	3.964	1.201	3.670	3
B-13 Use TDR / OTDR	3.836	1.026	3.945	1.129	3.491	5
C. Install and Maintain CATV network						
C-1 Read network engineering plot	3.911	1.225	4.200	1.238	4.056	5
C-2 Arrange suspended network	4.125	0.896	4.127	1.089	4.126	4
C-3 Arrange underground network	3.375	1.019	3.873	1.072	3.624	8
C-4 Connect electric cable	4.232	0.831	4.345	1.075	4.289	3
C-5 Connect optical fiber cable	3.107	1.155	4.291	1.117	3.699	7
C-6 Maintain suspended network	4.429	0.892	4.418	0.937	4.424	2
C-7 Maintain underground network	3.768	1.079	4.200	0.931	3.984	6
C-8 Inspect network failure	4.446	0.893	4.636	0.847	4.541	1
D. Install signal transmission equipment						
D-1 Read installation manual	3.375	1.169	3.782	1.166	3.579	2
D-2 Install and wiring	3.214	1.436	3.709	1.212	3.462	4
D-3 Install antenna	2.357	1.167	3.364	1.192	2.861	6
D-4 Install multi- and demultiplexer	2.232	1.144	3.164	1.214	2.698	7
D-5 Install optical fiber transmission equipment	2.625	1.105	3.764	1.232	3.195	5
D-6 Install microwave communication equipment	1.982	1.183	2.855	1.433	2.419	9
D-7 Install satellite communication equipment	2.071	1.126	2.945	1.353	2.508	8
D-8 Test signal transmission equipment	3.321	1.252	3.691	1.345	3.506	3
D-9 Maintain signal transmission equipment	3.518	1.236	3.891	1.212	3.705	1
E. Execute signal quality measurement						
E-1 Test electric wave leak	3.000	1.009	3.927	1.119	3.464	5
E-2 Test ground resistor	2.857	1.034	3.673	1.202	3.265	7
E-3 Test TV channel	3.661	1.180	4.036	1.216	3.849	1
E-4 Test cable FM channel	2.839	1.411	3.436	1.437	3.138	8
E-5 Test spectrum properties at subscriber end	2.982	1.231	3.836	1.229	3.409	6
E-6 Test signal stability at server end	3.482	1.388	4.036	1.232	3.759	2

E-7 Test TV modulator at server end	3.286	1.358	3.946	1.224	3.616	4
E-8 Test TV inverter at server end	3.304	1.334	3.964	1.201	3.634	3
F. Operate application software						
F-1 Operate word processing software	3.518	1.307	3.436	1.344	3.477	1
F-2 Operate electronic mail software	3.357	1.368	3.291	1.301	3.324	4
F-3 Operate internet software	3.554	1.264	3.345	1.294	3.450	2
F-4 Operate task management software	3.268	1.408	3.327	1.306	3.298	5
F-5 Operate graphic software	3.089	1.366	3.382	1.367	3.236	6
F-6 Operate circuit design software	3.232	1.335	3.509	1.289	3.371	3
G.Dispose of emergencies and contingencies						
G-1 Obey safety and hygiene regulations	3.982	1.286	4.182	1.234	4.082	2
G-2 Obey plant management regulations	3.857	1.313	4.218	1.100	4.038	3
G-3 Follow outage trouble-shooting procedure	3.518	1.144	4.291	1.083	3.905	4
G-4 Follow circuit failure trouble-shooting procedure	4.036	0.914	4.346	0.927	4.191	1
G-5 Follow broadcaster failure trouble-shooting procedure	3.054	1.394	3.600	1.180	3.327	8
G-6 Follow microwave failure trouble-shooting procedure	2.429	1.475	3.255	1.518	2.842	10
G-7 Follow satellite failure trouble-shooting procedure	2.661	1.468	3.363	1.366	3.149	9
G-8 Familiar with fire extinguisher and its operation	3.071	1.360	4.127	1.139	3.599	7
G-9 Familiar with escape procedures and skills	3.071	1.373	4.200	1.129	3.636	6
G-10 Familiar with first aid procedures and skills	3.179	1.377	4.218	1.117	3.699	5

Table 2 Competency items, levels, and suggested curricula in CATV required for graduates

Item	Sub-item	Level	Suggested Curricula
A. Select electronic components	A-1 Choose transmission cable	3	1. CATV components and inspection. 2. CATV engineering technique practice
	A-2 Choose connector	3	
	A-3 Choose splitter	3	
	A-4 Choose network amplifier	3、4	
	A-5 Choose equalizer cable	3、4	
	A-6 Choose plug-in attenuator	3、4	

	A-7 Choose distributor	3、4	
	A-8 Choose directional coupler	3、4	
	A-9 Choose power interrupter	3、4	
	A-10 Choose DC/AC power supply	3、4	
B. Use tools and equipment	B-1 Use hand tools	3	1. Electronics shop 2. Electronic meters 3. Measurement equipment and applications of CATV 4. Practice of CATV measurements
	B-2 Use power tools	3	
	B-3 Use dB meter	3	
	B-4 Use radio-frequency signal scan analyzer	4	
	B-5 Use system scan emitter	4	
	B-6 Use system scan receiver	4	
	B-7 Use network analyzer	4	
	B-8 Use TV test signal generator	4、3	
	B-9 Use waveform monitor	4、3	
	B-10 Use visual/base frequency signal general analyzer	4、3	
	B-11 Use electric wave sensor	4、3	
	B-12 Use spectrum analyzer	4、3	
	B-13 Use TDR / OTDR	4、3	
C. Install and Maintain CATV network	C-1 Read network engineering plot	3、4	1. CATV wiring construction and investigation 2. CATV practice (circuit) 3. Introduction to CATV system
	C-2 Arrange suspended network	3、4	
	C-3 Arrange underground network	3、4	
	C-4 Connect electric cable	4、3	
	C-5 Connect optical fiber cable	3	
	C-6 Maintain suspended network	3、4	
	C-7 Maintain underground network	3、4	
	C-8 Inspect network failure	3、4	
D. Install signal transmission equipment	D-1 Read installation manual	3、4	1. CATV signal source and its management 2. CATV practice (server end) 3. Antenna technique 4. Optical communication technique 5. Microwave communication technique
	D-2 Install and wiring	3、4	
	D-3 Install antenna	3、4	
	D-4 Install multi- and demultiplexer	4、3	
	D-5 Install optical fiber transmission equipment	4、3	
	D-6 Install microwave communication equipment	5、4	
	D-7 Install satellite communication equipment	5、4	

	D-8 Test signal transmission equipment	4、3	6. Satellite communication technique 7. Digital communication technique
	D-9 Maintain signal transmission equipment	4、3	
E. Execute signal quality measurement	E-1 Test electric wave leak	3、4	1. Measurement and inspection of CATV signals. 2. CATV practice (signal quality)
	E-2 Test ground resistor	3、4	
	E-3 Test TV channel	4	
	E-4 Test cable FM channel	4	
	E-5 Test spectrum properties at subscriber end	4	
	E-6 Test signal stability at server end	4	
	E-7 Test TV modulator at server end	4	
	E-8 Test TV inverter at server end	4	
F. Operate application software	F-1 Operate word processing software	3	1. Office software 2. Internet network 3. Design of CATV network
	F-2 Operate electronic mail software	3、4	
	F-3 Operate internet software	3	
	F-4 Operate task management software	4、3	
	F-5 Operate graphic software	4	
	F-6 Operate circuit design software	4	
G. Dispose of emergencies and contingencies	G-1 Obey safety and hygiene regulations	3	1. Industrial safety and related management 2. Industrial hygiene and related management 3. Maintenance of CATV network system
	G-2 Obey plant management regulations	3	
	G-3 Follow outage trouble-shooting procedure	3	
	G-4 Follow circuit failure trouble-shooting procedure	3	
	G-5 Follow broadcaster failure trouble-shooting procedure	3	
	G-6 Follow microwave failure trouble-shooting procedure	3、4	
	G-7 Follow satellite failure trouble-shooting procedure	3、4	
	G-8 Familiar with fire extinguisher and its operation	3	
	G-9 Familiar with escape procedures and skills	3	
	G-10 Familiar with first aid procedures and skills	3	

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