Curriculum for Training Professional Industrial Designer

Tzyy Wei Tzeng*, Dengchuan Cai ** and Lan Ling Huang***

** National Yunlin University of Science and Technology, Graduate School of Industrial Design*
g9731712@yuntech.edu.tw
*** National Yunlin University of Science and Technology, Department of Industrial Design*
caidc@yuntech.edu.tw
**** National Yunlin University of Science and Technology, Graduate School of Design Doctoral Program*
g9630806@yuntech.edu.tw

Abstract: This study proposed a new curriculum model which was able to satisfy the requirements of industrial development in Taiwan. Five parts were included: 1) an investigation and analysis of curriculum of each industrial design department in Taiwan; 2) an investigation of requirements of industrial designers; 3) a curriculum proposal satisfying industries' demands based on the result of questionnaire and specialist interview; 4) an evaluation on the curriculum by senior industrial designers through recursive DACUM method; and 5) an evaluation on the curriculum by the staffs of industrial design department. The characteristics of the curriculum can be summarized as following: 1) this curriculum plans 16 demands for conforming to vocational field. 2) establishing 4 cross-field programs (design technology, design creation, cultural innovation and multimedia application) for training second profession which can promote integrated competency; 3) practical training that providing an chance for confirming learned knowledge and skill, also with a early chance connecting with vocational field; and 4) encouraging undergraduates to join design competition and to apply for design patent that can improve confidence and creativity.

Keywords: design education, curriculum mode, vocational demands, design ability

1. Introduction

The curriculum is one of the best ways to cultivate the qualified students. To training professional industrial designers for the industry in Taiwan, the curriculum is needed to design for matching the industrial requirements. For the qualified industrial designers, they should enhance latest knowledge of product design and design trend, even more, strengthen the professional orientation and international vision. Students with verbal or graphic abilities tend to reflect difference onto various aspects of their studio performance. Thus, not only their design ability, hence synthetic thinking, varies but also their analytical thinking, in verbal and graphical terms differs. It is generally expected that those who can express their design idea using visual tools can be better designers (Ulusoy, 1999). Thus, it has an obvious close relation that diagnosing and training individual problem solving behavior maybe an essential contribution to optimize design processes and should be included in design

education in further vocational training (Eisentraut, 1997). Also, prior professional experience, such as competition or practical training, is helpful in understanding design theory (Verma, 1997). Therefore, integrating curriculum which conforms to vocational demands and practical application is indeed necessary.

The three educational domains (cognitive, affective and psychomotor) from Bloom (1965) are the most widely used today. Simpson (1972) reported the further study on psychomotor domain for improving this taxonomy even completed. The cognitive domain involves knowledge and the development of intellectual skills with 6 major categories which starts from the simplest to the most complex, also in the other 2 domains: knowledge, comprehension, application, analysis, synthesis and evaluation; the affective domain includes the manner deal with things emotionally, and contains 5 categories: receiving phenomena, responding to phenomena, valuing, organization and internalizing values (Bloom, 1965); the psychomotor domain includes physical skill areas which are measured in terms of speed, precision, distance, procedures or techniques in execution. It has 7 categories: perception, set, guided response, mechanism, complex, adaptation and origination. The necessary knowledge, affective abilities and practical manual skills of industrial design are all conforms these 3 domains.

DACUM (Developing A CurriculUM) method is an analysis job, process and systemic tool, which can identify the knowledge, skills, tools and attitudes required in a particular job. This study selects DACUM as one of the methods is since the professional talents from vocational field interpret the skills and abilities which are required in particular field; also, it is the most useful tool for identifying demands. Vocational talents need to converge particular skills, tools and attitude for accomplishing goal. The DACUM process is to modify a group of 8 to 12 experts with brainstorming to refine duties, tasks, knowledge, skills and attitudes under the guidance of a trained DACUM facilitator. The result will be displayed as a chart format (Welsh, 2008).

2. Information Collecting Process

This study aims to construct an industrial design curriculum for conforming the demands of Taiwan industry developments, which includes 5 stages: 1) collecting and analyzing the curriculum of industrial design departments in Taiwan for further research by Bloom's educational taxonomy; 2) investigating present demands from design industry by 2 ways that includes demands of industrial design related occupations on 104 Labor Resources Service, and interview with designers from vocational field; 3) survey to industrial design studio and in-house design department for investigating necessity of abilities; 4) organizing a industrial design curriculum; 5) evaluating and modifying the curriculum. The result of this study provides a curriculum that conforms to demands of industrial design field and practical application.

3. Curriculum of industrial design departments in Taiwan

The main purpose is to investigate curriculum of industrial design departments in Taiwan for further analysis and interpretation on developments of each and domain distribution of educational activities.

3.1 Method

By literature review and collection, this study aims at professional obligatory and elective courses with further classification on domain of educational activities. Researcher collected the present curriculum from 13

universities in Taiwan which includes: Tatung University, Dayeh University, National Taipei University of Technology, National Taiwan University of Science and Technology, National Chen Kung University, Ming Chi University of Technology, Tunghai University, Chang Gung University, National Kaohsiung Normal University, Chaoyang University of Technology, Huafan University, National Yunlin University of Science and Technology and National United University. Afterward, researcher arranged these curriculums as questionnaire and sent to chairperson of each school for dividing individual curriculum into three domains, cognitive, affective and psychomotor, according to its context and quality. Each course can be divided into multiple domains.

3.2 Result

By synthesizing curriculum scheme from 13 industrial design departments in Taiwan, the total average of cognitive domain is the highest with 50.96%. The main purpose of cognitive courses is to construct basic knowledge. Bloom (1965) had mentioned that, education of knowledge and concept is the most easier to express and teach. Also, it can be confirmed by examination or any type of test to affirm as memorization or interpretation. On the other hand, courses of affective and psychomotor are relatively less than cognitive domain by 17.71% and 31.33% that summarized in table 1. Curriculum of National Yunlin University of Science and Technology is especially unbalance; this study will focus on this problem and rearrange a curriculum.

Table 1. Average and distribution of educational activities in Taiwan

No.	School	Cognitive		Affective		Psychomotor	
		amount	%	amount	%	amount	%
1	Tatung University	26	46.4%	6	10.7%	24	42.9%
2	Dayeh University	52	61.2%	25	29.4%	8	9.4%
3	National Taipei University of Technology	28	47.5%	8	13.6%	23	39.0%
4	National Taiwan University of Science and Technology	24	40.7%	19	32.2%	16	27.1%
5	National Chen Kung University	15	45.5%	7	21.2%	11	33.3%
6	Ming Chi University of Technology	19	46.3%	7	17.1%	15	36.6%
7	Tunghai University	24	42.9%	7	12.5%	25	44.6%
8	Chang Gung University	32	59.3%	7	13.0%	15	27.8%
9	National Kaohsiung Normal University	21	34.4%	11	18.0%	29	47.5%
10	Chaoyang University of Technology	29	42.7%	10	14.7%	29	42.7%
11	Huafan University	46	63.9%	11	15.3%	15	20.8%
12	National Yunlin University of Science and Technology	44	74.6%	8	13.6%	7	11.9%
13	National United University	62	57.4%	13	12.0%	33	30.6%
	Total		51.0%		17.7%		31.3%

4. Demands of industrial design field in Taiwan

The method of this stage includes 2 parts: 1) demand research of industrial design related occupation on 104 Labor Resources Service; 2) survey on ability demands of industrial design field in Taiwan.

4.1 Abilities demand of industrial design related occupation

1) Method

The study investigates 20 related occupation of industrial design for latest 3 years, which includes product sale person, industrial designer and 200 units for each. Units for elementary and fine art teachers are insufficient for 66 and 51. Job vacancy, seniority, educational background, job experiences and graphic abilities are also included and summarized in this study.

2) Result

A) Job vacancy

The result shows that demand of product sale person is the most for 267 units, and vacancy of industrial designers is in secondary for 242 units. Fine art teacher is the most deficient for 59 units. The result is summarized in table 2.

Table 2. Result sorted by job vacancy

No	Vocations/ Job	Demand	No	Vocations/ Job	Demand
1	Product sales	267	11	Sales assistant	207
2	Industrial designer	242	12	Design assistant	198
3	Product service mechanic	227	13	Trademark patent officer	196
4	Marketing sales	224	14	Graphic designer	195
5	Product development	221	15	Product planning assistant	193
6	Product sale manager	221	16	Sale project chief	192
7	Mechanic	221	17	High schoolteacher	189
8	Market manager	215	18	Exhibition planning assistant	188
9	Market analyst	214	19	Elementary schoolteacher	64
10	Project planning assistant	208	20	Fine art teacher	59
				Total	3941

B) Seniority

The average seniority of manager requires 4-year seniority; project planning and designer require seniority of over 2 years. Graphic drafter and teacher require 1-year seniority, and the result is summarized in table 3.

Table 3. Result sorted by seniority

					Seniority							Seniority	
No	Job types	N	Mean	SD	N	%	No	Job types	N	Mean	SD	N	%
1	Sale project executive	200	4.5	2.29	8	4	11	Trademark patent officer	200	2.2	1.13	59	29.5
2	Project executive	200	4.5	2.34	13	6.5	12	Project planning assistant	200	2.1	1.23	40	20
3	Product sale executive	200	4.1	2.13	9	4.5	13	Product service mechanic	200	2.0	1.36	62	31
4	Project sale chief	200	3.9	1.86	11	5.5	14	Elementary schoolteacher	200	2.0	1.47	26	39.4
5	Marketing analyst	200	3.0	2.06	46	23	15	Graphic drafter	200	1.8	1	72	36
6	Product planning	200	2.8	1.55	39	19.5	16	Mechanic	200	1.8	0.99	68	34
7	Industrial designer	200	2.7	1.74	28	14	17	High schoolteacher	200	1.8	1.17	87	43.5
8	Exhibition planning	200	2.5	1.52	51	25.5	18	Sale assistant	200	1.6	1	66	33
9	Sales marketing assistant	200	2.45	1.3	32	16	19	Design assistant	66	1.5	0.74	86	43
10	Product sales	200	2.42	1.4	58	29	20	Fine art teacher	51	1.4	0.7	24	47.1

C) Educational background

Design chief and engineer require diploma of university; vacancy of assistant requires college diploma and the result is summarized in table 4.

Table. 4 . Result sorted by educational background

	Job types	else		High school		College		Undergraduate		Master		Doctor	
		Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	Trademark patent officer					17	8.5	163	81.5	20	10.0		
2	High school teacher	3	1.5	4	2.0	44	22.0	143	71.5	2	1.0	4	2.0
3	Product planning chief	3	1.5	3	1.5	49	24.5	135	67.5	9	4.5	1	0.5
4	Elementary schoolteacher	3	4.5	1	1.5	18	27.5	44	66.7				
5	Project manager	2	1.0	5	2.5	52	26.0	127	63.5	13	6.5	1	0.5
6	Sale planning chief	4	2.0	1	0.5	56	28.0	126	63.0	13	6.5		
7	Marketing analyst	4	2.0	12	6.0	35	17.5	121	60.5	28	14.0		
8	Project executive	1	0.5	5	2.5	71	35.5	118	59.0	5	2.5		
9	Industrial designer	2	1.0	9	4.5	86	43.0	101	50.5	2	1.0		
10	Sale planning assistant	4	2.0	8	4.0	75	37.5	100	50.0	12	6.0	1	0.5
11	Product developer	6	3.0	15	7.5	66	33.0	100	50.0	13	6.5		
12	Product sales	8	4.0	40	20.0	64	32.0	80	40.0	8	4.0		
13	Product service mechanic	5	2.5	26	13.0	115	57.0	51	25.5	3	1.5		
14	Activities planning	8	4.0	10	5.0	99	49.5	75	37.5	8	4.0		
15	Exhibition planning	20	10.0	67	33.5	95	47.5	18	9.0				
16	Sales marketing assistant	4	2.0	23	11.5	94	47.0	76	38.0	3	1.5		
17	Mechanic	19	9.5	67	33.5	93	46.5	20	10.0	1	0.5		
18	Design assistant	24	12.0	79	39.5	89	44.5	8	4.0				
19	Fine art teacher	2	3.9	6	11.8	22	43.1	20	39.2	1	2.0		
20	Graphic drafter	21	10.5	96	48.0	76	38.0	7	3.5				

D) Types of experience

This analysis focuses on the type of industrial designer-related job. According to the result, field requires experiences of industrial design and product forming related background; second, it requires experience of 3C and electronic product design background. The information is summarized in table 5.

Table 5. Types of design experiences

No	Types	Frequency	No	Types	Frequency
1	Industrial design	23	11	Technology development	4
2	Product forming	23	12	Mechanism design	3
3	3C Product design	13	13	Vehicle related design	3
4	Electronic product design	11	14	Shoes related design	3
5	Daily-use product design	8	15	Plastic product design	2
6	Hardware design and development	8	16	Stationary design	2
7	Exercise equipment	5	17	LED apply design	2
8	Project development	5	18	Software design	2
9	Manufacture process	5	19	Furniture design	2
10	IT industry	4	20	Interface design	2

E) Abilities of graphic abilities

As one of the most important and basic abilities, the most demand is PhotoShop, CorelDraw and Illustrator in 2D field. In 3D software, ProE, AutoCad and SolidWorks are required mostly and the information is showed in table 6.

Table 6. Abilities of graphic abilities

2D Software	Frequency	3DSoftware	Frequency
PhotoShop	39	Pro/E	60
CorelDraw	28	AutoCad	33
Illustrator	24	SolidWorks	26
Flash	4	Alias	18
Imitation ability	2	CINEMA 4D	13
Al	1	Rhino	10
Random type	1	CATIA	6
Painter	1	3D Max	6
DreamWeaver	1	WildFire	5
PhotoImpact	1	UG	3

F) Other related design abilities

According to the study, designers should require 7 basic abilities: integrating (39.5%), design and expression (25%), quality controlling (17.3%), individual working (13.8%), manufacture process (4.8%), language (3.4%) and planning (2.7%). In integrating ability, demand of coordination is especially important that is focus on communicate with other individual departments or customers. For expressing ideas and communicating to customers immediately, sketch is the most important of graphic abilities. Besides, English is indeed necessary for communicating with foreign customer and expressing idea clearly. In addition, industrial designers need to be requiring enthusiasm of design, aggressiveness, responsibility, innovation and precise perceptiveness.

5. Survey

The study investigates present ability demands of vocational field by survey, and also analyzes the result for precise requirements.

1) Method

The subject is 106 design studio and in-house design department in Taiwan and retrieves 14 units, which includes 66 effective questionnaires. The content is constructed by 3 parts: 1) types of field; 2) ability demands; 3) work content of designers. The 17 items of this survey are refers to Ho and Cai's (1999) survey, and synthesizes the above investigation of labor service web. The survey has 17 ability items.

2) Result

A) Types of field

According to the investigated result, the field is ranked by the most to the less: daily equipments (37), 3C product (31), consumer electronics (27) and vehicle (23). The information is summarized in figure 1.

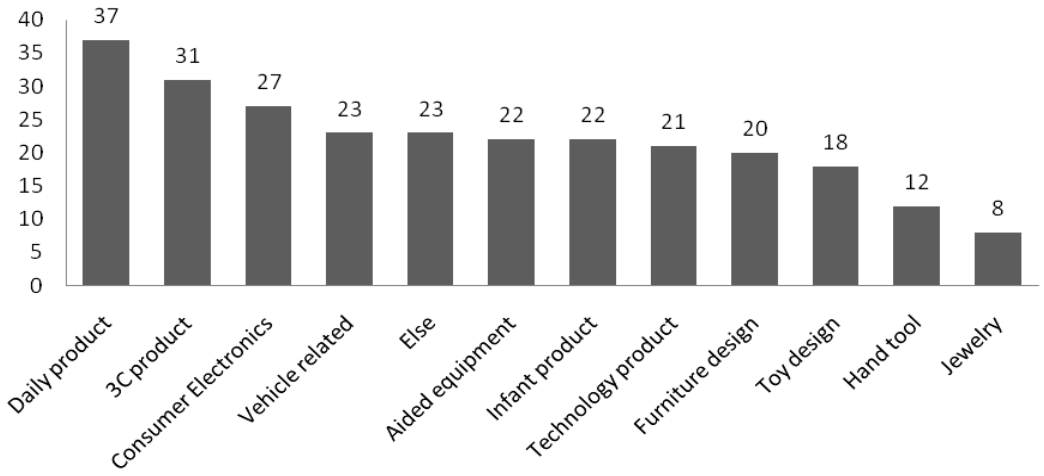

Figure.1 Types of field

B) Ability demands of vocational field

The result shows that the innovative thinking (4.78), idea expression (4.67), aethestic (4.66), product design (4.65) and forming ability (4.62) are the most important 5 abilityies, and summerizes below in figure 2.

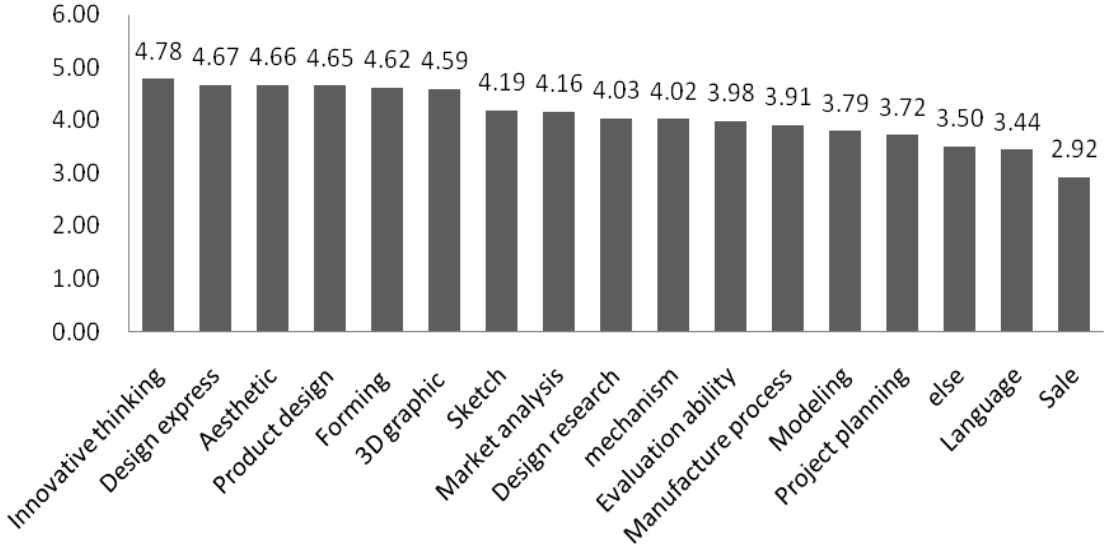

Figure.2 Ability demands of vocational field

C) Work content of designers

Figure 3 shows the investigation on work content. Forming (43), product design (42), modeling (20) and product planning (19) are the most 4 contents in industrial design field.

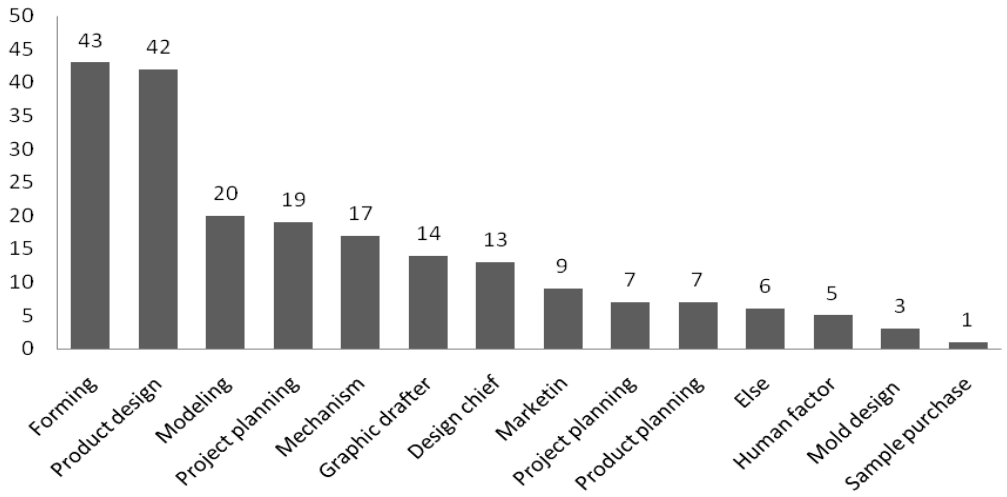

Figure.3 Work content of designers

6. Curriculum designed by Recursive DACUM

According to the above results, the study arranges a new curriculum by Recursive DACUM. The subject is 4 experienced industrial designers and their average vocational year is 8 years. The subject is selected by work contents, company location and educational background for avoiding similar condition. The process focuses on the courses and strategy of the practicing curriculum that includes cross-field program, design competition and design monopoly. Further, the subjects also evaluate and give suggestions to this curriculum for achieving the main purpose of this study. The study processes by Recursive DACUM, and interviews only one design expert meantime. The interview result will be arrange in order and analyzed. The information will showed to the next interviewee and asked for further suggestions. The process continues until that the 4 subject all agree the rearranged curriculum. Eventually, the final result will be questionnaire and sent to more than 100 professional designers for confirm. The result of retrieved survey will be further analyzed and modified.

The study summarizes 3 main characters as following:

a) 4 interviewees all agree the final curriculum. The 3 main abilities, includes design graphic ability, aesthetic and creativity, are the focus of this study; besides, the other abilities are considered as basic requirements.

b) The 4 interviewees agree the curriculum strategy which includes cross-field programs, practical training, competition record and design monopoly, that constructed by the study. Cross-field programs can enhance the multiple developments of students by interests. Furthermore, practical training helps students to know the practical requirements; also, students can reveal their flaws by the duration of training. The most important is to gather vocational experiences. In addition, the competition record shows the enthusiasm of design, confidence and basic abilities of a student. These characters are all indeed beneficial in the career. Moreover, the competition record emphasizes personal experience; it also can be a standard that shows better design abilities. Monopoly can be a index as innovative thinking and the student can expected to develop more innovative developments.

c) The study made a survey of 100 questionnaires and retrieved 80. The retrieved 80 units all agree with the curriculum.

The curriculum constructed by Recursive DACUM and survey will be evaluated by 13 curriculum committee of industrial design department of National Yunlin University of Science and Technology for detail affirmation and modification. The evaluated subjects are curriculum content and the strategy of cross-field programs, practical training, competition record and design monopoly.

7. Industrial design curriculum arrangement and modification

The main purpose of this curriculum is for conforming to the ability demands of vocational field, ascertaining the educated knowledge be practicable and training professional abilities of design. According to the result of 104 Labor Source Service and survey, the study configures curriculum that conforms to vocational industrial field for following characters:

1) Industrial design curriculum: for fulfilling the basic 16 abilities mentioned by this study.
2) 4 cross-field programs: training the minor skill by 4 cross-field programs for further competitiveness. The programs include design technology, design creativity, cultural creativity and multimedia apply program that show in figure 4.
3) Participation to design competition and monopoly: raising confidence and creativity of students.
4) Advancing practical training: verifying learned abilities and having advance connection with vocational field, for knowing flaws and making further self training.

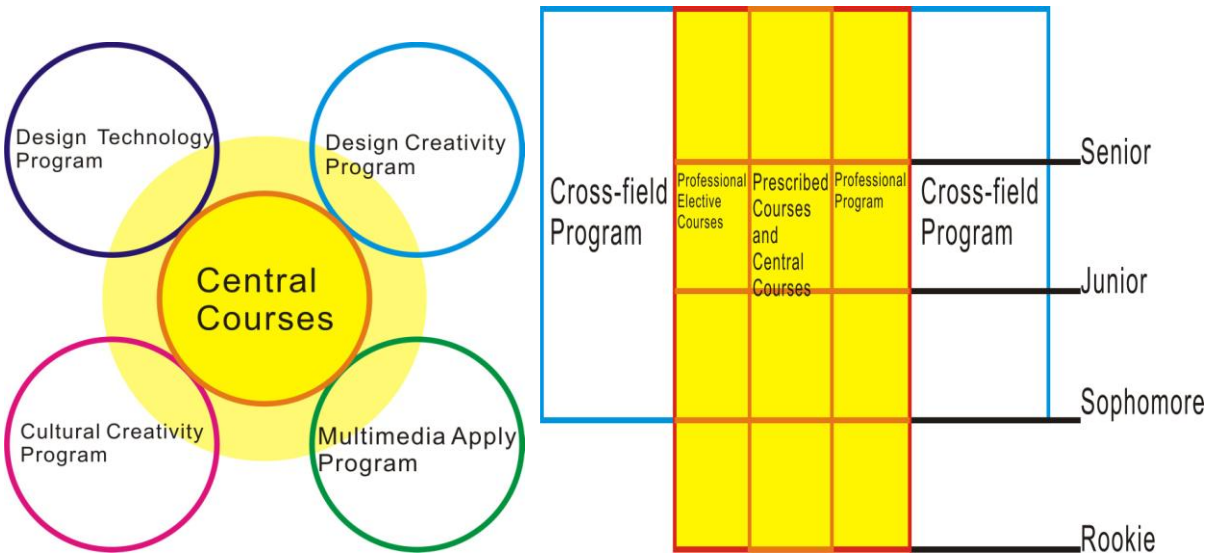

Figure. 4 4 cross-field programs sorted by the study

8. Conclusion

The characters of the curriculum constructed by the study are: 1) conforming to the basic 16 abilities; 2) 4 cross-field programs (design technology, design creativity, cultural creativity and multimedia apply) as minor for competitiveness; 3) participating competition enthusiastically and gaining monopoly for providing confidence

and creativity; 4) advancing practical training that proves learned abilities and knowledge; it also provides chance to connect with vocational field for knowing flaws and making further self training. The result is evaluated by professional industrial designers and schoolteachers; and the curriculum can enhance students conforming to ability demands of vocational field and practical application.

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