Identifying the Course Network Structures Based upon Records of In-service Learning Database

Lung-Hsing Kuo
National Kaohsiung Normal University
No.116, Heping 1 st Rd., Lingya District, Kaohsiung City 802, TAIWAN(R.0.C.)
admi@nknucc.nknu.edu.tw

&

Hsieh-Hua Yang

Oriental Institute of Technology

No.58, Sec. 2, Sichuan Rd., Banqiao City, Taipei County 220, Taiwan

Republic of China

yansnow@gmail.com

&

Jui-Chen Yu

National Science And Technology Museum

#720 Ju-Ru 1st Rd., Kaohsiung

Taiwan

raisin@mail.nstm.gov.tw

&

Hung-Jen Yang
Department of Industrial Technology Education
National Kaohsiung Normal University
No.116, Heping 1 st Rd., Lingya District, Kaohsiung City 802, TAIWAN(R.0.C.)
hjyang@nknucc.nknu.edu.tw

&

Lydia Lin
National Kaohsiung Normal University
No.116, Heping 1 st Rd., Lingya District, Kaohsiung City 802, TAIWAN(R.0.C.)
baubaubo@hotmail.com

Abstract: -The purpose of this study focused on the social network structure of in-service development for the Chinese literature expertise teachers in Taiwan High school. Social network analysis methods include the core measures, identification of groups to analyze the role, figure based on the statistical analysis and so on. In this study we use 2009 National Teacher in-service Education Information Network (http://inservice.edu.tw/) database to obtain 5,417 sample resources. The expected result should be able to understand Chinese literature teacher in-service refresher training expertise in the overall network of centricity, teachers participate in studies course subject categories and countries connected, education seminar for subgroups generated number, subgroups on overall network impact, etc.

Key-Words: In-service development, Social network structure, High school, UCINET, Chinese literature teacher

1 Introduction

In recent years, our environments are driven by changes in society, fast growth by science, technology and knowledge development. Teachers as an educational provider should change with the environment, enhance their professional abilities and to give students a better quality of education. In order to enhance teacher quality, Teacher Education Act and Teacher-Law are provided legal basis of in-service advancement education for teachers. Therefore to participate in in-service advancement education can be seen as a duty and responsibility for them. Teachers can spent their time to study variety of in-service advancement education courses at schools, In-service teacher advancement education agencies, Universities with teacher education, Universities without the department of teacher education or Life-long learning organizations. That is providing opportunities for professional growth, the possibility of continuing study and improving teaching knowledge of teachers.

There are more in-service advancement education studies focus on junior high, elementary school teachers. According to the Electronic Theses and Dissertations System, from year 1976 to year 2009 there are 110 topics of in-service advancement education for teachers searched by keywords; Study subjects are elementary school teachers are 59 topics; junior high school teachers are 13 topics; elementary and junior high school teachers are 3 topics [1]. However, there are only one topic study high school teachers. Therefore we can see in-service advancement education for high school teachers are worth to study. In addition, Chinese, the official national language in Taiwan is the most important subjects especially we focus more on writing and reading skills for students in recent years. Thus, Chinese literature teachers in high school are the research subjects in this study.

Furthermore, the in-service advancement education studies are more focused on the job training status, factors (including psychological needs and motivations, policy implications, willingness and …etc), teaching effectiveness, perception and conflict of role, carry out the strategies and methods of in-service advancement education, discussion on in-service advancement education time and in-service advancement education training system for international comparison. Although some studies of in-service advancement education are related to teachers who

teaching in a single major field (subject), but they have the main issues which we mentioned before. There are less relevant studies on in-service advancement education courses and contents for teachers' teaching subjects. Therefore this study aims to focus on the social network structure of in-service advancement education for the high school Chinese literature teachers by course categories.

1.1 Aim of the study

The research goals in this study are:

- To understand the overall network centrality of Chinese literature teacher in in-service advancement education.
- To understand the relation on study course categories which attended by Chinese literature teachers.
- To find subgroup(s) of similarity and how does the subgroup(s) impact on overall network.

1.2 Key Concepts and Terms

- **Course Categories:** in this study we focus on the course categories rather than subjects. The course categories have 3 layers; the 1st layer are "teaching", "administration" and "other"; the 2nd layer is divided from 1st layer, it has 83 categories; the 3rd layer is divided from 2nd layer it contents 249 course categories.
- **Nodes and edges:** Nodes are the objects or interest (e.g. subjects, people, groups, organizations, and other connected information/knowledge entities.) and the edges are the relations among the nodes. [2]
- **Degree centrality:** Degree is the number of direct relations to other nodes. Degree centrality is the measurement to measure the relative importance on direct connections of nodes in a network.[3][4]
- **Components:** are sets of nodes connected by edges but components are not connected to each other. [2]
- **Isolates:** nodes are isolate when the nodes have no relations with any other node.[2]
- **Cutpoint(s):** It would increase the number of components if we removed a node and we called this node is the cutpoint.[2]
- **Markov Cluster Algorithm:** This is one of the methods to find subgroups. Markov Cluster algorithm partitions a graph into

non-overlapping clusters. The algorithm determines the appropriate number of clusters deduced from the structural properties of the graph.[3][5]

1.3 Assumption

Social network analysis is concerned with social relations between nodes and it can be presented in the graph drawing. We assume this social network graph is a dependence graph in which edges are independent if they do not share a node. This means in this study the social behavior of an individual teacher in-service advancement education courses should be influenced only by

its courses, not by individuals to which it does not have any kind of relation.[5]

2 Study Design
2.1 Research subjects

In this study the subjects are the high school Chinese literature teachers attending in-service advancement education activities in Taiwan. We use 2009 National Teacher in-service Advancement Education Information Network (http://inservice.edu.tw/) database to obtain 5417 sample resources. The basic data analysis are shown in Table 1, Table 2. and Table 3.

Table 1. Number of high school Chinese literature teachers attending in-service advancement education activities by location and school type

Location	No. of teachers by school type		
	Public Schools	Private Schools	Totals
Taipei city	660	180	840
Kaohsiung City	305	69	374
Taipei County	583	245	828
Yilan County	57	22	79
Taoyuan County	239	214	453
Hsinchu County	79	40	119
Miaoli County	102	43	145
Taichung County	171	227	398
Changhua County	116	52	168
Nantou County	80	12	92
Yunlin County	89	52	141
Chiayi County	37	20	57
Tainan County	172	84	256
Kaohsiung County	231	21	252
Pingtung County	112	30	142
Taitung County	34	1	35
Hualien County	38	32	70
Penghu County	15	0	15
Keelung City	84	33	117
Hsinchu City	109	62	171
Taichung City	178	135	313
Chiayi City	45	53	98
Tainan City	113	123	236
Kinmen County	15	0	15
Lienchiang County	3	0	3
Totals	**3667**	**1750**	**5417**

Lung-Hsing Kuo, Hsieh-Hua Yang, Jui-Chen Yu, Hung-Jen Yang, Lydia Lin

Table 2. Number of high school Chinese literature teachers attending in-service advancement education activities in public school by age group and sex

Age group	Sex		Totals
	Female	Male	
22-29	295	43	338
30-34	508	80	588
35-39	629	102	731
40-44	685	128	813
45-49	529	131	660
50-54	294	78	372
55-59	83	50	133
60above	12	20	32
Totals	3035	632	3667

Table 3. Number of high school Chinese literature teachers attending in-service advancement education activities in private school by age group and sex

Age group	Sex		Totals
	Female	Male	
22-29	274	25	299
30-34	249	68	317
35-39	230	55	285
40-44	261	72	333
45-49	147	54	201
50-54	102	40	142
55-59	78	50	128
60 above	16	29	45
Totals	1357	393	1750

2.2 Data Analysis

In this study the software University of California Irvine of Network Programs (UCINET 6.281) is used to analyze the relationship of network matrix to define the network position. The methods include centrality measures, blocks & cutpoints, subgroups identification and we use NetDraw 2.092 function to perform the relationship between matrix and Social Network graph drawing. Finally analysis report is given.

3 Results

This study aims to focus on the social network structure of in-service advancement education for the high school Chinese literature teachers. Table 4. is the course category frequency table for high school Chinese literature teachers attending in-service advancement education.

The table shows course category "teaching_language _Mandarin" has the highest frequency followed by "administration_ Education Affairs_ other", "administration_ School discipline and guidance",

Lung-Hsing Kuo, Hsieh-Hua Yang, Jui-Chen Yu, Hung-Jen Yang, Lydia Lin

"teaching_other" and "teaching_other_other".

Table 4.The course category frequency table for high school Chinese literature teachers attending in-service advancement education.

1st	2nd	3rd	totals
Teaching	Language	Mandarin	13041
Administration	Educational Affairs	Other	7167
Administration	School discipline and guidance	Other	6105
Teaching	Other	Other	5709
Teaching	Information Technology Education	Other	3894
Teaching	Language	Other	2515
Administration	Other	Other	1806
Teaching	Integrative Activity	Other	706
Administration	General Affairs	Other	622
Teaching	Gender Equality Education	Other	567
Teaching	Arts and Humanities	Other	522
Teaching	General Curriculum in Special Education	Apply Special Education	460
Teaching	School discipline and guidance	Other	377
Teaching	Language	English	369
Administration	Personnel & Accounting	Other	362
Teaching	Social Study	Other	353
Teaching	Life Education	Introduction to Life Education	315
Teaching	Moral Education	Other	308
Teaching	Health and Physical Education	Health	292
Teaching	Math	Other	287
Teaching	Arts and Humanities	Arts and Life	283
Teaching	Environmental Education	Other	254
Administration	Library Management	Other	246
Teaching	Language Arts	Mandarin	231
Teaching	Health and Physical Education	Other	227
Teaching	Human Rights Education	Other	224
Teaching	Social Study	History	207
Teaching	Language	Local Language	196
Teaching	Science	Other	176
Teaching	Career Development Education	Other	167
Teaching	Health and Physical Education	Health and Nursing	161
Teaching	Social Study	Civics and Social Study	155
Teaching	Health & Leisure	Health and Self Management	153
Teaching	Arts and Humanities	Fine Arts	147
Teaching	Arts and Humanities	Music	136
Teaching	General Curriculum in Special Education	Other	111
Teaching	Integrative Activity	Counseling Activity	109
Teaching	General Curriculum in Special Education	Special Education Concepts	108
Teaching	Career Planning	Other	104
Teaching	Health and Physical Education	Physical Education	100
Teaching	Life Education	Other	99
Teaching	Arts and Humanities	Performing Arts	93
Teaching	severe emotional disturbance	Other	87
Administration	Job Practice	Other	85
Teaching	Health	Other	82
Teaching	Home Economic and Life Technology	Home Economics	80
Teaching	autism	Curriculum for Autism Education	77
Teaching	Physically and Mentally Disabled	other significant handicaps	71
Teaching	Science	Biology	71
Teaching	autism	Other	68
Teaching	Introduction to Special Education	Other	66
Teaching	Social Study	Geography	65
Teaching	Science	Physics	62
Teaching	learning disabilities	Other	61
Teaching	Health & Leisure	Health and Emotion	60
Teaching	Gifted	Other	57
Teaching	General Education in National Defense	Other	55
Teaching	Area of Arts and Humanities	Arts and Life	51
Teaching	Science and Technology	Life Technology	50

1st	2nd	3rd	totals
Teaching	Life Education	Personality Integrated and Other	46
Teaching	Science and Technology	Other	45
Other	Other	Other	42
Teaching	Health and Medical Technology	Dept. of Nursing	39
Teaching	Physically and Mentally Disabled	learning disabilities	38
Teaching	Home Economic and Life Technology	Life Technology	35
Teaching	Introduction to Special Education	Introduction to Special Education	35
Teaching	Business	Other	34
Teaching	Life Culture	Food Making and Culture	34
Teaching	Life Culture	Other	34
Teaching	Science and Technology	Biology	33
Teaching	Arts and Humanities	Mandarin	32
Teaching	severe emotional disturbance	Curriculum for Emotional and Other	32
Teaching	Educational Affairs	Other	31
Teaching	Home Economics Education	Other	30
Teaching	Arts and Humanities	Visual Arts	29
Teaching	Business	Dept. of Clerical Affairs	29
Teaching	Physically and Mentally Disabled	severe emotional disturbance	29
Teaching	Life Education	Sex and Marriage Morality	28
Teaching	Introduction to Special Education	Advanced Curriculum for Religion and Life	27
Teaching	Life Education	Other	27
Teaching	the gifted	Other	27
Teaching	Area of Health and Physical Education	Health and Nursing	25
Teaching	Language Arts	Other	25
Teaching	Language Arts	Department of English	24
Teaching	Life Culture	Image Management and Other	24
Administration	Information Technology Education	Other	23
Teaching	Arts	Other	23
Teaching	Home Economic and Life Technology	Other	23
Teaching	Area of Arts and Humanities	Music	22
Teaching	Physically and Mentally Disabled	autism	22
Teaching	Life Education	Life and Death Care	21
Teaching	Science	Earth Science	21
Teaching	Life Education	Philosophy and Life	19
Teaching	mental retardation	Curriculum for Mental Retardation	17
Teaching	Area of Science	Biology	16
Teaching	Gender Equality Education	Local Language	16
Teaching	Language	second foreign language	14
Teaching	learning disabilities	Curriculum for Learning impaired	14
Teaching	the gifted	Curriculums for Gifted Students	14
Teaching	Area of Social Study	Other	13
Teaching	Physically and Mentally Disabled	multiple impairments	13
Teaching	Physically and Mentally Disabled	Other	13
Teaching	severe emotional disturbance	Discussion and Analysis of career	13
Administration	Job Practice	Other	10
Teaching	Area of Life	Other	10
Teaching	Gifted	general intelligence	10
Teaching	Science	Chemistry	10
Teaching	Business	Dept. of Data Processing	9
Teaching	Life Education	Moral Thinking and Decision	9
Administration	Child Care	Other	8
Teaching	Area of Social Study	History	8
Teaching	Home Economics	Dept. of Early Childhood Care	8
Teaching	Home Economics	Food Science Cluster	8
Teaching	Integrative Activity	Home Economics	8
Teaching	Integrative Activity	Scout Education	8
Teaching	Music	Other	8
Teaching	Physically and Mentally Disabled	mental retardation	8
Teaching	Science and Technology	Physics	8

1st	2nd	3rd	totals
Teaching	Game	Other	7
Teaching	Business	Dept. of International Trade	6
Teaching	Hearing impairments	Curriculum for Hearing-impaired	6
Administration	Environmental Education	Other	5
Teaching	Health & Leisure	Other	5
Teaching	Health and Medical Technology	Other	5
Teaching	hearing impairments	Other	5
Teaching	mental retardation	Other	5
Teaching	Physically and Mentally Disabled	developmental retardation	5
Teaching	Physically and Mentally Disabled	hearing impairments	5
Administration	Arts and Humanities	Other	4
Teaching	Area of Health and Physical Education	Physical Education	4
Teaching	Area of Social Study	Civics and Social Study	4
Teaching	Business	Dept. of Advertisement	4
Teaching	Gifted	scholastic aptitude	4
Teaching	Industrial	Dept. of Auto Mechanics	4
Teaching	Industrial	Other	4
Teaching	visual impairment	Other	4
Administration	Health	Other	3
Teaching	Area of Life	Home Economics	3
Teaching	Arts	Dept. of Dance	3
Teaching	Arts	Dept. of Drama	3
Teaching	Business	Dept. of Tourism Service	3
Teaching	Science and Social Study	Other	3
Teaching	Science and Technology	Earth Science	3
Teaching	Arts	Dept. of Film & Television	2
Teaching	Arts and Humanities	History	2
Teaching	Health	Health and Nursing	2
Teaching	Health and Medical Technology	Dept. of Childhood Education	2
Teaching	Hospitality	Dept. of Restaurant Management	2
Teaching	Industrial	Dept. of Computer Science	2
Teaching	Information Technology Education	Dept. of Data Processing	2
Teaching	Language Arts	Department of Japanese	2
Teaching	language disorders	Other	2
Teaching	Physically and Mentally Disabled	health impairments	2
Teaching	Physically and Mentally Disabled	physical handicaps	2
Teaching	Physically and Mentally Disabled	visual impairment	2
Teaching	the gifted	Apply Assessment	2
Administration	Job Practice	practice	1
Administration	School discipline and guidance	learning disabilities	1
Teaching	Agriculture	Dept. of Food Processing	1
Teaching	Area of Arts and Humanities	Fine Arts	1
Teaching	Area of Arts and Humanities	Other	1
Teaching	Arts	Dept. of Chinese Music	1
Teaching	Arts	Dept. of Refrigerator &	1
Teaching	Electronics & Electrical Engineering	Dept. of Computer Science	1
Teaching	General Military Defense	Other	1
Teaching	Gifted	artistic talent	1
Teaching	Home Economics	Dept. of Beautification	1
Teaching	Home Economics	Dept. of Clothing Making	1
Teaching	Home Economics	Home Economics	1
Teaching	Home Economics	Other	1
Teaching	Hospitality	Other	1
Teaching	Music	Performing Arts	1
Teaching	Power Machinery Cluster	Other	1
Teaching	visual impairment	Curriculum for Visually Impaired	1
Total			52044

Lung-Hsing Kuo, Hsieh-Hua Yang, Jui-Chen Yu, Hung-Jen Yang, Lydia Lin

Table 5. The Degree centrality of course categories

Course Categories	Degree	NrmDegree	Share
Administration_Educational Affairs_Other	159	91.908	0.021
Teaching_Other_Other	159	91.908	0.021
Teaching_Language_Mandarin	158	91.329	0.021
Administration_School discipline and guidance_Other	158	91.329	0.021
Teaching_Information Technology Education_Other	150	86.705	0.02
Administration_Other_Other	139	80.347	0.018
Teaching_Language_Other Humanities_Other	136	78.613	0.018
Teaching_Arts and	116	67.052	0.015
Teaching_General Curriculum in Special Education_Apply Special Education	114	65.896	0.015
Teaching_Integrative Activity_Other	106	61.272	0.014
Teaching_Gender Equality Education_Other	105	60.694	0.014
Administration_Personnel&Accounting_Other	98	56.647	0.013
Administration_General Affairs_Other	98	56.647	0.013
Teaching_Language_English	96	55.491	0.013
Teaching_Life Education_Introduction to Life Education	96	55.491	0.013
Teaching_Social Study_Other	95	54.913	0.012
Teaching_Arts and Humanities_Fine Arts	94	54.335	0.012
Teaching_Environmental Education_Other	90	52.023	0.012
Teaching_Social Study_History	87	50.289	0.011
Teaching_School discipline and guidance_Other	87	50.289	0.011
Teaching_Moral Education_Other	86	49.711	0.011
Teaching_Health and Physical Education_Health	86	49.711	0.011
Teaching_Math_Other	86	49.711	0.011
Teaching_Human Rights Education_other	85	49.133	0.011
Teaching_Health and Physical Education_Other	85	49.133	0.011
Teaching_Arts and Humanities_Music	85	49.133	0.011
Teaching_Arts and Humanities_Arts and Life	83	47.977	0.011
Teaching_Career Development Education_Other	81	46.821	0.011
Teaching_Health and Physical Education_Health and Nurseing	80	46.243	0.01
Teaching_Health & Leisure_Health and Self Management	80	46.243	0.01
Administration_Library Management_Other	77	44.509	0.01
Teaching_Science_Other	77	44.509	0.01
Teaching_learning disabilities_Other	75	43.353	0.01
Teaching_Language_Local Language	75	43.353	0.01
Teaching_Career Planning_Other	75	43.353	0.01
Teaching_autism_Other	75	43.353	0.01
Teaching_Science_Biology	74	42.775	0.01
Teaching_Social Study_Civics and Social Study	73	42.197	0.01
Teaching_Language Arts_Mandarin	72	41.618	0.009
Teaching_Social Study_Geography	69	39.884	0.009
Teaching_Life Education_Other	69	39.884	0.009
Teaching_Integrative Activity_Counseling Activity	69	39.884	0.009
Teaching_General Curriculum in Special Education_Other	69	39.884	0.009
Teaching_Health and Physical Education_Physical Education	68	39.306	0.009
Teaching_General Curriculum in Special Education_Education Concepts	67	38.728	0.009
Administration_Job Practice_Other	67	38.728	0.009
Teaching_severe emotional disturbance_Other	66	38.15	0.009
Teaching_Gifted_Other	65	37.572	0.009
Teaching_Health & Leisure_Health andEmotion Management	64	36.994	0.008
Other_Other_Other	63	36.416	0.008
Teaching_Life Education_Personality Integrated and Spiritual Development	62	35.838	0.008
Teaching_Health_Other	62	35.838	0.008
Teaching_Physically and Mentally Disabled_other significant handicaps	59	34.104	0.008
Teaching_Science and Technology_Other	59	34.104	0.008
Teaching_Home Economic and Life Technology_Home Economics	58	33.526	0.008
Teaching_Introduction to Special Education_other Humanities_Performing Arts	58	33.526	0.008
Teaching_Arts and	57	32.948	0.007
Teaching_Life Education_Life and Death Care	56	32.37	0.007
Teaching_severe emotional disturbance_Curriculum for Emotional and	55	31.792	0.007
Teaching_autism_Curriculum for Autism Education	52	30.058	0.007
Teaching_Life Education_Religion and Life	51	29.48	0.007
Teaching_Life Culture_Other	47	27.168	0.006
Teaching_Home Economic and Life Technology_Life Technology	47	27.168	0.006
Teaching_Life Education_Philosophy and Life	46	26.59	0.006
Teaching_Arts_Other	46	26.59	0.006
Teaching_Science and Technology_Biology	46	26.59	0.006
Teaching_Home Economics Education_Other	45	26.012	0.006
Teaching_Business_Dept. of Clerical Affairs	44	25.434	0.006
Teaching_Physically and Mentally Disabled_Learning disabilities	44	25.434	0.006
Teaching_Home Economic and Life Technology_Other	44	25.434	0.006
Teaching_Educational Affairs_Other	43	24.855	0.006
Teaching_Area of Arts and Humanities_Arts and Life	43	24.855	0.006
Teaching_Science_Physics	43	24.855	0.006
Teaching_Health and Medical Technology_Dept. of Nursing	43	24.855	0.006
Teaching_mental retardation_Curriculum for Mental Retardation Education	43	24.855	0.006
Teaching_Area of Arts and Humanities_Arts and Life of Health and Physical Education	42	24.277	0.006
Teaching_Life Culture_Food Making and Culture	42	24.277	0.006
Teaching_Life Education_Sex and Marriage Morality	41	23.699	0.005
Administration_Child Care_Other	41	23.699	0.005
Teaching_Area of Life_Other	39	22.543	0.005
Teaching_Language Arts_Department of English	38	21.965	0.005
Teaching_Arts and Humanities_Visual Arts	37	21.387	0.005
Teaching_General Education in National Defense_other	36	20.809	0.005
Teaching_Physically and Mentally Disabled_mental retardation	35	20.231	0.005
Teaching_Health & Leisure_Other	33	19.075	0.004
Teaching_Physically and Mentally Disabled_autism	33	19.075	0.004
Teaching_Life Education_Moral Thinking and Decision Making	33	19.075	0.004
Teaching_Area of Arts and Humanities_Music	33	19.075	0.004
Teaching_learning disabilities_Curriculum for Learning impaired Education	32	18.497	0.004
Administration_Job Practice_Other	32	18.497	0.004
Teaching_Physically and Mentally Disabled_severe emotional disturbance	32	18.497	0.004
Teaching_Science_Earth Science	31	17.919	0.004
Teaching_Life Culture_Image Management and Fashion	31	17.919	0.004
Teaching_Physically and Mentally Disabled_Other	31	17.919	0.004
Teaching_Area of Social Study_Other	30	17.341	0.004
Teaching_Science and Technology_Life Technology	30	17.341	0.004
Teaching_Business_Other	29	16.763	0.004
Teaching_Language Arts_Other	29	16.763	0.004
Teaching_Area of Science_Biology	27	15.607	0.004
Teaching_severe emotional disturbance_Discussion and Analysis of	26	15.029	0.003
Teaching_the gifted_Curriculums for Gifted Students	26	15.029	0.003
Teaching_Game_Other	26	15.029	0.003
Teaching_hearing impairments_Other	25	14.451	0.003
Teaching_Music_Other	25	14.451	0.003
Teaching_Language_second foreign language	25	14.451	0.003
Teaching_Science_Chemistry	24	13.873	0.003
Administration_Arts and Humanities_Other	23	13.295	0.003
Teaching_Physically and Mentally Disabled_multiple impairments	23	13.295	0.003
Teaching_Gifted_general intelligence	22	12.717	0.003
Teaching_Introduction to Special Education_Introduction to Special Education	22	12.717	0.003
Teaching_Physically and Mentally Disabled_hearing impairments	21	12.139	0.003
Teaching_Integrative Activity_Home Economics	21	12.139	0.003
Teaching_Gifted_scholastic aptitude	20	11.561	0.003
Teaching_hearing impairments_Curriculum for Hearing-impaired Education	20	11.561	0.003
Teaching_Arts and Humanities_History	20	11.561	0.003
Teaching_Physically and Mentally Disabled_visual impairment	19	10.983	0.002
Teaching_mental retardation_Other	19	10.983	0.002
Teaching_Integrative Activity_Scout Education	18	10.405	0.002
Teaching_Physically and Mentally Disabled_health impairments	18	10.405	0.002
Administration_Job Practice_practice	18	10.405	0.002
Teaching_Health and Medical Technology_other	17	9.827	0.002
Teaching_Area of Health and PhysicalEducation_Physical Education	17	9.827	0.002
Teaching_Area of Arts and Humanities_Fine Arts	17	9.827	0.002
Teaching_Area of Life_Home Economics	16	9.249	0.002
Teaching_the gifted_Apply Assessment	16	9.249	0.002
Teaching_Physically and Mentally Disabled_developmental retardation	16	9.249	0.002
Administration_Environmental Education_Other	16	9.249	0.002
Teaching_Science and Technology_Physics	16	9.249	0.002
Teaching_Arts and Humanities_Mandarin	16	9.249	0.002
Administration_School discipline and guidance_Learning disabilities	15	8.671	0.002
Teaching_Introduction to Special Education_Advanced Curriculum for Special	15	8.671	0.002
Teaching_Language Arts_Department of Japanese	15	8.671	0.002
Teaching_Home Economics_Other	13	7.514	0.002
Teaching_Gender Equality Education_Language	13	7.514	0.002
Teaching_Area of Social Study_History	13	7.514	0.002
Administration_Health_Other	13	7.514	0.002
Teaching_Home Economics_Food Science Cluster	12	6.936	0.002
Teaching_Business_Dept. of Data Processing	12	6.936	0.002
Teaching_Science and Social Study_other	12	6.936	0.002
Teaching_Arts_Dept. od Dance	11	6.358	0.001
Teaching_Home Economics_Dept. of Early Childhood Care	11	6.358	0.001
Teaching_Science and Technology_Earth Science	11	6.358	0.001
Administration_Information Technology Education_Other	10	5.78	0.001
Teaching_Arts_Dept. of Drama	10	5.78	0.001
Teaching_Physically and Mentally Disabled_physical handicaps	10	5.78	0.001
Teaching_visual impairment_Other	10	5.78	0.001
Teaching_Area of Social Study_Civics and Social Study	10	5.78	0.001
Teaching_Business_Dept. of Advertisement	10	5.78	0.001
Teaching_Health and Medical Technology_Dept. of Childhood Education	9	5.202	0.001
Teaching_Industrial_Dept. of Auto Mechanics	8	4.624	0.001
Teaching_Electronics & Electrical Engineering_Dept. of Computer Science	8	4.624	0.001
Teaching_Health_Health and Nursing	8	4.624	0.001
Teaching_Home Economics_Dept. of Clothing Making	8	4.624	0.001
Teaching_Industrial_Other	8	4.624	0.001
Teaching_Arts_Dept. of Drama Refrigerator & Air-conditioning	7	4.046	0.001
Teaching_Business_Dept. of Tourism Service	7	4.046	0.001
Teaching_Hospitality_Dept. of Restaurant Management	7	4.046	0.001
Teaching_Arts_Dept. of Film & Television	7	4.046	0.001
Teaching_visual impairment_Curriculum for Visually Impaired Education	7	4.046	0.001
Teaching_language disorders_Other	6	3.468	0.001
Teaching_Gifted_artistic talent	6	3.468	0.001
Teaching_the gifted_Other	6	3.468	0.001
Teaching_Agriculture_Dept. of Food Processing	5	2.89	0.001
Teaching_Hospitality_Other	5	2.89	0.001
Teaching_General Military Defense_Other	4	2.312	0.001
Teaching_Information Technology_Dept. of Data Processing	4	2.312	0.001
Teaching_Business_Dept. of International Trade	4	2.312	0.001
Teaching_Music_Performing Arts	4	2.312	0.001
Teaching_Arts_Dept. of Chinese Music	4	2.312	0.001
Teaching_Power Machinery Cluster_Other	3	1.734	0
Teaching_Home Economics_Dept. of Beautification	3	1.734	0
Teaching_Area of Arts and Humanities_Other	2	1.156	0
Teaching_Industrial_Dept. of Computer Science	2	1.156	0
Teaching_Home Economics_Home Economics	1	0.578	0

Table 6. descriptive statistics

		Degree	NrmDegree	Share
		-----------	-----------	-----------
1	Mean	43.874	25.360	0.006
2	Std Dev	36.485	21.090	0.005
3	Sum	7634.000	4412.717	1.000
4	Variance	1331.179	444.779	0.000
5	SSQ	566556.000	189300.016	0.010
6	MCSSQ	231625.219	77391.570	0.004
7	Euc Norm	752.699	435.086	0.099
8	Minimum	1.000	0.578	0.000
9	Maximum	159.000	91.908	0.021

Network Centralization = 67.32%

Heterogeneity = 0.97%.　Normalized = 0.40%

Fig.1. the top 20 strongest degree centrality of course categories.
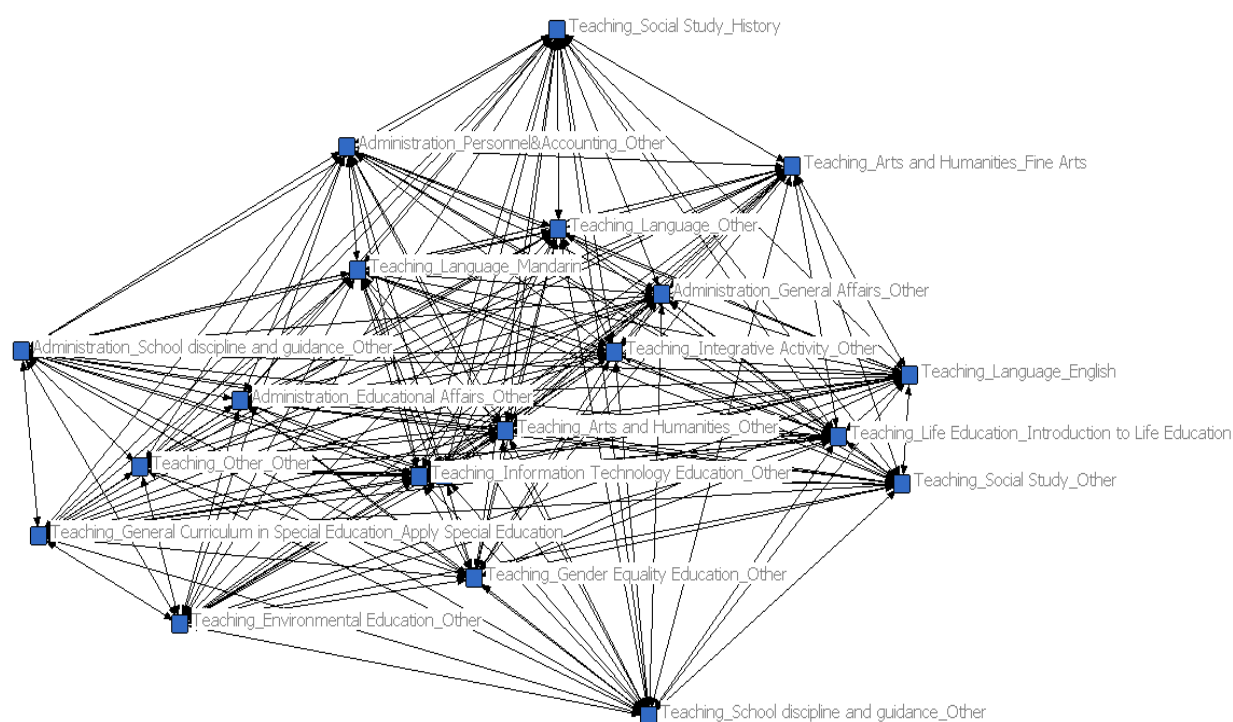
Centrality- degree

The Degree centrality of the relative importance on direct connections of course categories in this network is shown in Table 5. The Table 6 shows the mean of the degree centrality on course categories is 43.874; The mean of normalized degree centralities on course categories is 25.360 %. "Administration_ Educational Affairs_ Other", "Teaching_Other_Other", "Teaching_ Language_ Mandarin" and "Administration_School discipline and guidance_Other" has the highest degree

Blocks & cutpoints

Figure 2. and Figure 3. are the graphs shows the blocks and cutpoint in this network. There are two blocks and one cutpoint found. "teaching_language_ Mandarin" is the cutpoint. Block one is the cutpoint

centrality followed by "Teaching_ Information Technology Education_ Other". This means these in-service advancement education course categories has the most maximum possible number of direct connections to other course categories for the high school Chinese literature teachers. The whole network centralization is 67.32%, which indicate there is a medium high centrality in this newtwork. Figure 1. simplify the whole network graph which shows the top 20 strongest degree centrality of course categories.

("teaching_language_ Mandarin") links to "Teaching_Home Economics_ Home Economics" and vice versa; block two is the cutpoint ("teaching_language_Mandarin") and other course categories except "Teaching_Home Economics_ Home Economics" forms a network.
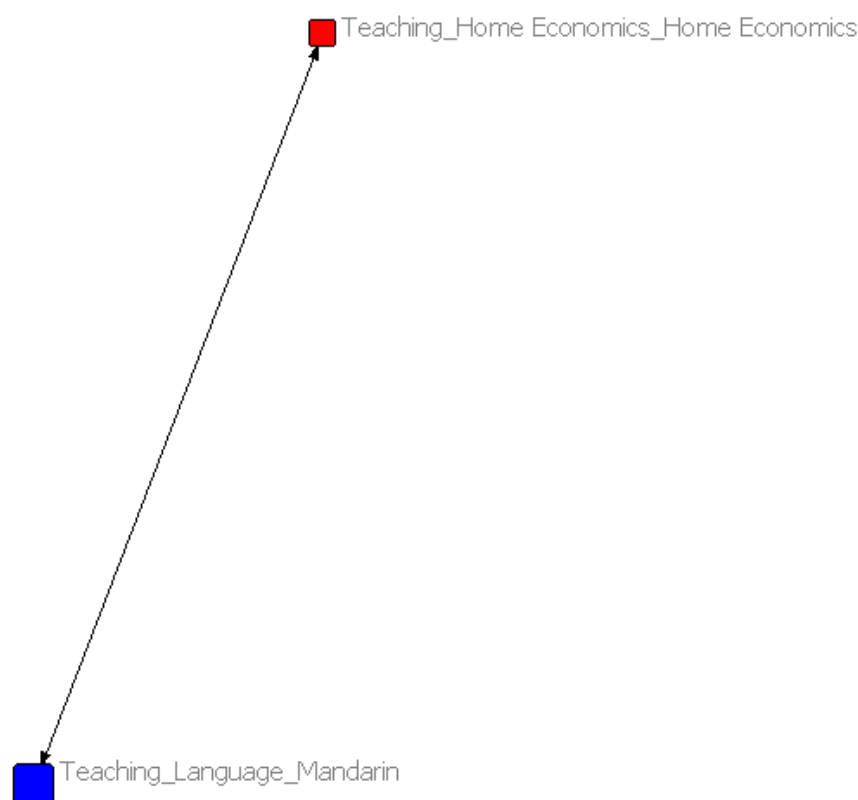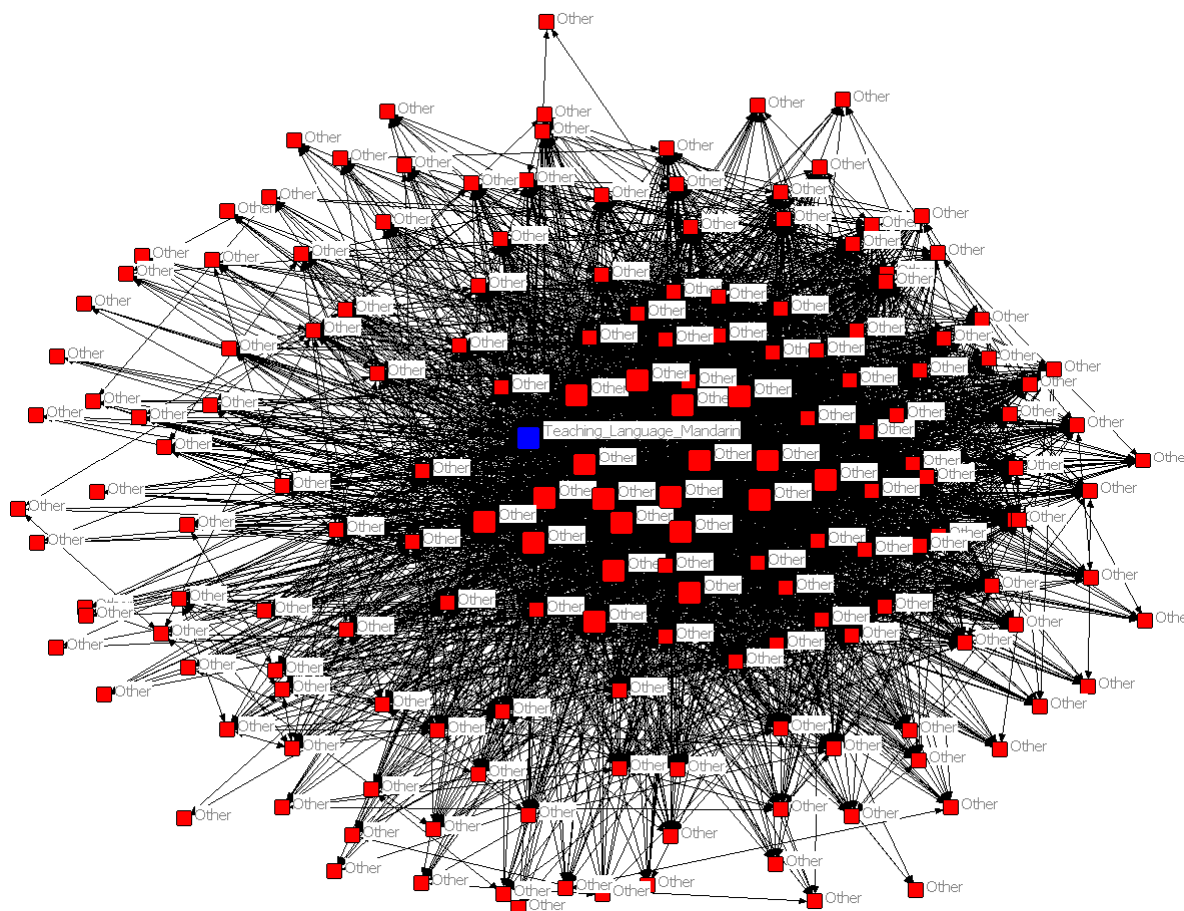

Fig.2 Block 1

Figure.3. Block 2

Subgroups

By using Markov clustering algorithm there are 4 subgroups found. Cluster 1 has 149 course categories members, cluster 2 has 16 course categories members, cluster 3 has 6 course categories members and cluster 4 has 3 course categories members.

4   Conclusions

This study aims to focus on the social network structure of in-service advancement education for the high school Chinese literature teachers by course categories. The conclusions are made as the following:

- The high school Chinese literature teachers attending "teaching_ language_ Mandarin" related courses most frequently. That indicates high school Chinese literature teachers continue to study their major field of teaching.

- "Administration_Educational Affairs_ Other", "Teaching_ Other_ Other", "Teaching_

Language_ Mandarin" and "Administration_ School discipline and guidance_Other" has the highest degree centrality followed by "Teaching_ Information Technology Education_Other". This means these in-service advancement education course categories has the most maximum possible number of direct connections to other course categories for the high school Chinese literature teachers. That because there are some promotion policies from the Ministry of Education or local Education Departments that needs teachers to promote, such as anti-drug propaganda, sexual assaults preventions…etc.

This network is dominated by "Teaching_ Language_ Mandarin". If this course category is removed or damaged, the network will quickly fragment into unconnected sub-networks. In this case "Teaching_ Home Economics_ Home Economics" will be isolate in this network.

Table 7. Clusters of Course categories by Markov clustering algorithm

Course Categories	Cluster	Course Categories	Cluster	Course Categories	Cluster	Course Categories	Cluster
Administration_Arts and Humanities_Other	1	Education_Apply Special Education	1	Teaching_Language_second foreign language	1	Teaching_autism_Other	1
Administration_Child Care_Other	1	Teaching_General Curriculum in Special Education_Other	1	Teaching_Life Culture_Food Making and Culture	1	Teaching_hearing impairments_Curriculum for Hearing-impaired Education	1
Administration_Environmental Education_Other	1	Teaching_General Curriculum in Special Education_Special Education Concepts	1	Teaching_Life Culture_Image Management and Fashion	1	Teaching_hearing impairments_Other	1
Administration_General Affairs_Other	1	Teaching_General Education in National Defense_Other	1	Teaching_Life Culture_Other	1	Teaching_learning disabilities_Curriculum for Learning impaired Education	1
Administration_Health_Other	1	Teaching_Gifted_Other	1	Teaching_Life Education_Introduction to Life Education	1	Teaching_learning disabilities_Other	1
Administration_Information Technology Education_Other	1	Teaching_Gifted_general intelligence	1	Teaching_Life Education_Life and Death Care	1	Teaching_mental retardation_Curriculum for Mental Retardation Education	1
Administration_Job Practice_Other	1	Teaching_Gifted_scholastic aptitude	1	Teaching_Life Education_Moral Thinking and Decision Making	1	Teaching_mental retardation_Other	1
Administration_Job Practice_career	1	Teaching_Health & Leisure_Health and Emotion Management	1	Teaching_Life Education_Other	1	Teaching_severe emotional disturbance_Curriculum for Emotional and Behavioral Disorders Education	1
Administration_Job Practice_practice	1	Teaching_Health & Leisure_Health and Self Management	1	Teaching_Life Education_Personality Integrated and Spiritual Development	1	Teaching_severe emotional disturbance_Discussion and Analysis of Emotional and Behavioral Disorders for Individual Students	1
Administration_Library Management_Other	1	Teaching_Health & Leisure_Other	1	Teaching_Life Education_Philosophy and Life	1	Teaching_severe emotional disturbance_Other	1
Administration_Personnel&Accounting_Other	1	Teaching_Health and Medical Technology_Dept. of Childhood Education	1	Teaching_Life Education_Religion and Life	1	Teaching_the gifted_Apply Assessment	1
Administration_School discipline and guidance_learning disabilities	1	Teaching_Health and Medical Technology_Dept. of Nursing	1	Teaching_Life Education_Sex and Marriage Morality	1	Teaching_the gifted_Curriculums for Gifted Students	1
Other_Other_Other	1	Teaching_Health and Medical Technology_Other	1	Teaching_Math_Other	1	Teaching_visual impairment_Curriculum for Visually Impaired Education	1
Teaching_Area of Arts and Humanities_Arts and Life	1	Teaching_Health and Physical Education_Health	1	Teaching_Moral Education_Other	1	Teaching_visual impairment_Other	1
Teaching_Area of Arts and Humanities_Fine Arts	1	Teaching_Health and Physical Education_Health and Nursing	1	Teaching_Music_Other	1	Administration_Educational Affairs_Other	2
Teaching_Area of Arts and Humanities_Music	1	Teaching_Health and Physical Education_Other	1	Teaching_Other_Other	1	Administration_School discipline and guidance_Other	2
Teaching_Area of Health and Physical Education_Health and Nursing	1	Teaching_Health and Physical Education_Physical Education	1	Teaching_Physically and Mentally Disabled_Other	1	Teaching_Agriculture_Dept. of Food Processing	2
Teaching_Area of Health and Physical Education_Physical Education	1	Teaching_Health_Health and Nursing	1	Teaching_Physically and Mentally Disabled_autism	1	Teaching_Arts_Dept. of Chinese Music	2
Teaching_Area of Life_Home Economics	1	Teaching_Health_Other	1	Teaching_Physically and Mentally Disabled_developmental retardation	1	Teaching_Arts_Dept. of Film & Television	2
Teaching_Area of Life_Other	1	Teaching_Home Economic and Life Technology_Home Economics	1	Teaching_Physically and Mentally Disabled_health impairments	1	Teaching_Business_Dept. of Data Processing	2
Teaching_Area of Science_Biology	1	Teaching_Home Economic and Life Technology_Life Technology	1	Teaching_Physically and Mentally Disabled_hearing impairments	1	Teaching_Business_Dept. of International Trade	2
Teaching_Area of Social Study_Civics and Social Study	1	Teaching_Home Economic and Life Technology_Other	1	Teaching_Physically and Mentally Disabled_learning disabilities	1	Teaching_Home Economics_Food Science Cluster	2
Teaching_Area of Social Study_History	1	Teaching_Home Economics Education_Other	1	Teaching_Physically and Mentally Disabled_mental retardation	1	Teaching_Hospitality_Dept. of Restaurant Management	2
Teaching_Area of Social Study_Other	1	Teaching_Home Economics_Dept. of Early Childhood Care	1	Teaching_Physically and Mentally Disabled_multiple impairments	1	Teaching_Industrial_Dept. of Auto Mechanics	2
Teaching_Arts and Humanities_Arts and Life	1	Teaching_Home Economics_Other	1	Teaching_Physically and Mentally Disabled_other significant handicaps	1	Teaching_Industrial_Dept. of Computer Science	2
Teaching_Arts and Humanities_Fine Arts	1	Teaching_Human Rights Education_Other	1	Teaching_Physically and Mentally Disabled_severe emotional disturbance	1	Teaching_Information Technology Education_Dept. of Data Processing	2
Teaching_Arts and Humanities_History	1	Teaching_Industrial_Other	1	Teaching_Physically and Mentally Disabled_visual impairment	1	Teaching_Music_Performing Arts	2
Teaching_Arts and Humanities_Mandarin	1	Teaching_Information Technology Education_Other	1	Teaching_School discipline and guidance_Other	1	Teaching_Physically and Mentally Disabled_physical handicaps	2
Teaching_Arts and Humanities_Music	1	Teaching_Integrative Activity_Counseling Activity	1	Teaching_Science and Social Study_Other	1	Teaching_language disorders_Other	2
Teaching_Arts and Humanities_Other	1	Teaching_Integrative Activity_Home Economics	1	Teaching_Science and Technology_Biology	1	Teaching_the gifted_Other	2
Teaching_Arts and Humanities_Performing Arts	1	Teaching_Integrative Activity_Other	1	Teaching_Science and Technology_Earth Science	1	Administration_Other_Other	3
Teaching_Arts and Humanities_Visual Arts	1	Teaching_Integrative Activity_Scout Education	1	Teaching_Science and Technology_Life Technology	1	Teaching_General Military Defense_Other	3
Teaching_Arts_Dept. of Dance	1	Teaching_Introduction to Special Education_Advanced Curriculum for Special Education	1	Teaching_Science and Technology_Other	1	Teaching_Gifted_artistic talent	3
Teaching_Arts_Dept. of Drama	1	Teaching_Introduction to Special Education_Introduction to Special Education	1	Teaching_Science and Technology_Physics	1	Teaching_Home Economics_Dept. of Clothing Making	3
Teaching_Arts_Dept. of Refrigerator & Air-conditioning	1	Teaching_Introduction to Special Education_Other	1	Teaching_Science_Biology	1	Teaching_Hospitality_Other	3
Teaching_Arts_Other	1	Teaching_Language Arts_Department of English	1	Teaching_Science_Chemistry	1	Teaching_Power Machinery Cluster_Other	3
Teaching_Business_Dept. of Advertisement	1	Teaching_Language Arts_Department of Japanese	1	Teaching_Science_Earth Science	1	Teaching_Area of Arts and Humanities_Other	4
Teaching_Business_Dept. of Clerical Affairs	1	Teaching_Language Arts_Mandarin	1	Teaching_Science_Other	1	Teaching_Home Economics_Dept. of Beautification	4
Teaching_Business_Dept. of Tourism Service	1	Teaching_Language Arts_Other	1	Teaching_Science_Physics	1	Teaching_Home Economics_Home Economics	4
Teaching_Business_Other	1	Teaching_Language_English	1	Teaching_Social Study_Civics and Social Study	1		
Teaching_Career Development Education_Other	1	Teaching_Language_Local Language	1	Teaching_Social Study_Geography	1		
Teaching_Career Planning_Other	1	Teaching_Language_Mandarin	1	Teaching_Social Study_History	1		
Teaching_Educational Affairs_Other	1	Teaching_Language_Other	1	Teaching_Social Study_Other	1		
Teaching_Electronics & Electrical Engineering_Dept. of Computer Science	1			Teaching_autism_Curriculum for Autism Education	1		
Teaching_Environmental Education_Other	1						
Teaching_Game_Other	1						
Teaching_Gender Equality Education_Local Language	1						
Teaching_Gender Equality Education_Other	1						
Teaching_General Curriculum in Special	1						

Lung-Hsing Kuo, Hsieh-Hua Yang, Jui-Chen Yu, Hung-Jen Yang, Lydia Lin

- There are 4 subgroups found in this network. The cluster 1 course categories is the major subgroup in this network; it is the largest and has the most power to impact on this network, followed by cluster 2, 3 and 4. If the cluster 1 course categories is removed or damaged, the network will quickly collapse.

Correspondingly, we sought to elucidate whether social network could be applied to identify relationships and roles. Other on-line activities might be also becoming impact to learners, such on-line PBL, mobile device for learning and integrated information providing. [6, 7, 8] It is suggested that further study could be conducted.

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