"KNOWLEDGE INHERITANCE IN TRADITIONAL CHINESE MEDICINE (TCM): (ON MASTER-DISCIPLE EDUCATION METHOD IN TCM EDUCATION)"

Jifa Gu
Academy of Mathematics and Systems Science, CAS
Rui Gao, Lantao Li
Xiyuan Hospital of China Academy of Chinese Medical Sciences
Zhengxiang Zhu, Wuqi Song
School of Management, Dalian University of Technology

ABSTRACT

Traditional Chinese Medicine has his old history and accumulated a lot of rich experiences and thoughts, but how can we inherit them is a difficult problems, since some of them are tacit knowledge. From 2006 we had participated into a large project sponsored by Ministry of Science and Technology. The purpose of this large project was designed for collecting and maintaining the idea, experiences, knowledge and wisdom from selected 100 veteran TCM masters. We wish use the advanced IT technology and systems science to mine the main ideas and experiences from each of them and also to find their collective experiences and thoughts. We also wish to improve the old traditional master-disciple education method in TCM to learn the phronesis from the veteran TCM doctors.

I. INTRODUCTION

In order to inherit the experiences and thoughts from veteran TCM doctors we wish use the general education method by university education system and study by oneself, but we also have to pay attention the old tradition of teaching by master personally, so called master-disciple education method. Recent years for catching the information times there is a lot of information and computer technique, such as multi-media, data base, knowledge base, data mining and machine learning used in TCM universities and institutes in educating the students and doctors also. We wish combine the advanced computer technology, systems science and knowledge science to improve the master-disciple education method.

II. SOME IDEAS AND METHODS

2.1.ABC analysis

ABC analysis is a business term used to define an inventory categorization technique. ABC analysis provides a mechanism for identifying different categories of stock that will require different management and controls. These categories are called ABC codes:

"A class" inventory will typically contain items that account for 80% of total value, or 20% of total items;

"B class" inventory will have around 15% of total value, or 30% of total items;

"C class" inventory will account for the remaining 5%, or 50% of total items.

Here we may classify all knowledge as inventory also into three classes: "A class" knowledge is more strategic, creative one; "B class" is technical, creative one; "C class" is general scientific one (see Figure1).

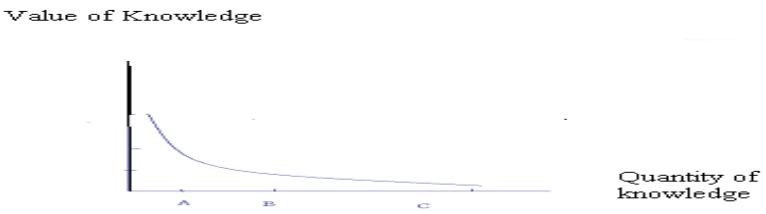

Figure 1. ABC knowledge

For different class TCM knowledge we may use different methods to educate and inherit them. Here we will introduce some methods and theory, which will help people to mining, educating and inheriting TCM knowledge.

2.2.Data mining and domain driven DM (DDDM)

Usually from a large amount of data, information we may use data mining to discover the knowledge, but usually they may find only the first order knowledge (here it corresponds to the first order (C) class knowledge), which seems too large, rough and very hard to use. So now some researchers try use the other methods, such as Domain –Driven Data mining to find the knowledge with more interesting (or we call it as second order (B) class knowledge) and more actionable knowledge (or we call it third order (A) class knowledge, which will ask the experts to help [Zhu, Gu 2008, Zhu, Gu et al, 2008]. We may find the correspondence between them as following:

Mining first order (C)---quantity-general Knowledge.

Mining second order(B)-efficiency-interesting Knowledge.

Mining third order (A)---effective-actionable Knowledge.

2.3. Expert mining

Unlike the data mining the objects we deal with mainly are large quantity of data and information or explicit knowledge, expert mining (EM) mainly deal with directly the live experts with small quantity.

We may classify all experts in EM:

E^0 general people	(C)	general knowledge.(opinion)
E^1 expert with specific Knowledge.	(B)	specific knowledge.
E^2 master；	(A)	creative knowledge.
E^3 guru;	(A)	strategic knowledge.

In different situations we will use different methods for EM[Gu et al, 2008]

2.4.Aristotle's three types of knowledge

Aristotle had proposed following three concepts for classifying knowledge

Episteme (Scientific Knowledge):

Universal, context-free and objective knowledge (explicit knowledge)

Techne (Skills and Crafts Knowledge):

Practical and context-specific technical know-how (tacit knowledge）

Phronesis (Prudence/Practical Wisdom):

Experiential knowledge to make context-specific decisions based on one's own value/ethics (high quality tacit knowledge) [Nonaka, Toyama, 2007, Hiranabe, 2009,]

2.5.Phronesis

Phronesis is a concept that synthesizes "knowing why" as in scientific theory, with "knowing how" as in practical skill, and "knowing what" as a goal to be realized. Unlike episteme, it emphasizes practices in particular contexts. However, phronesis is not just knowledge within a certain, particular context per se. Since it is knowledge to serve the "common good", it implies an affinity with universal principles.

Prof. Nonaka presents six abilities that constitute phronesis;

Ability to make a judgment on goodness.[Direction]

Ability to share contexts with others to create *ba*(shared sense).[Facilitation]

Ability to grasp the essence of particular situations/things.[Grasp]

Ability to reconstruct the particulars into universals using language/ concepts/ narratives. [Abstract]

Ability to use any necessary means well to realize concepts for common goodness. [Realization]

Ability to foster phronesis in others to build resilient organization. [Organization]

Gu changes the order of six abilities by Nonaka as process of realizing phronesis:

1. grasp the essence
2. abstract to theory
3. run exchange, inter-discipline, facilitation
4. realize technique
5. organize group
6. guide by worldview (see Figure 2).

Or we may shorten them as

1. Creation } ***wisdom***
2. Abstraction }
3. Facilitation } ***practice***
4. Realization }
5. Organization } ***goodness***
6. Orientation }

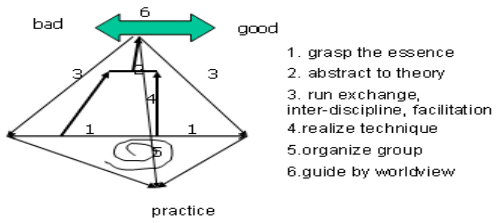

Figure 2. Process of running phronesis by Gu

III. MASTER-DISCIPLE EDUCATION METHOD IN TCM EDUCATION

Recently we wish run a new project "On Master-Disciple education method in TCM education" supported by NSFC. The intentions of this project are:

1. develop the traditional master-disciple education method,
2. utilize the computer and the expert mining to dig the experiences from famous elder TCM doctors ,
3. use the combination of human and computer,
4. inherit experiences by the combination of master and disciple,
5. develop the phronesis(practical wisdom)

3.1.Modern IT methods for inheriting the elder famous TCM doctors

Based on the methodology platform for constructing the methods for inheriting the elder famous TCM doctors, adopting the comparison and integration of knowledge obtained from the traditional method of teaching by master personally and expert mining by using modern IT technology we summarize the academic thoughts and features while taking the TCM doctor Wen W.L. and Wei Z.X. as the carrier. we wish develop an expert mining platform based on the domain driven by clinical experience from elder famous doctors to support the inheritance of their experience and thoughts. At the same time we will develop a learning software to collect the clinical cases and integrate the mining knowledge, provide the technical support to inherit and learn the veteran doctor’s experiences

3.2. Traditional Master-Disciple education method

Traditional Master-Disciple education method is an important education method for keeping the specific features of TCM and inheriting the TCM diagnosis characteristics. It emphases the direct exchange and match between master and disciple. It promotes the more close relationship between master and disciple. It benefits for inheriting the tacit knowledge from master, considering the flexibility, personality during TCM

diagnosis. It is one of the method for TCM education and should be complemented with other modern education methods [Jia, 2005,Liu, 2003, Wang, 2005] In order to keep the tradition ,when the disciples wish to learn the masters, usually they will follow the special ceremony[see Figure 3]

Figure 3. Ceremony for respecting the masters by disciples

3.3 Contemporary mode for inheriting the experiences and thoughts

We design a contemporary mode for inheriting the experiences and thoughts[see Figure 4]

（1）*Theoretical study*: Read specified classical books on TCM; sort out the papers written by masters

（2）*Study followed by master*:

1) time in a week no less than 1.5 working days; total time within two years no less than 120 working days;

2) number of clinical cases collected from masters no less 1000 cases;

3) making records;

（3）*Clinical practice*: time for clinical practice in a week no less 2 working days; total time within two years no less 150 working days

（4）*Making conclusion on the inheriting master's experience and thoughts;* develop the academic knowledge base for own master.

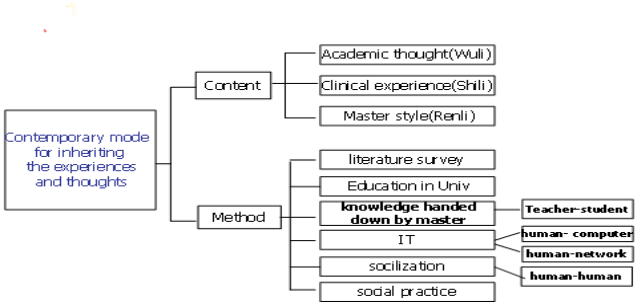

Figure 4. Contemporary mode for inheriting the TCM Experiences and thoughts

3.4. The combination of Expert mining and computational techniques

The combination of Expert mining and computational techniques provides the important support for analyzing the complex clinical data and finding the deep thoughts and laws

Expert Mining(EM) is a new emergent mining method for digging the thoughts and wisdom directly from experts. It is different with the data mining, text mining and web mining, which usually are based on the huge number of samples and are analyzed on the base of statistical analysis. EM will be based on the small number of samples and analyzed by deep analysis from experts and through deep and vivid discussion between experts with the support of computer and new tools for analyzing the discussion results. EM uses the systems science, noetic science, computer science and knowledge science with the help of advanced IT technology[Gu,et al,2008, Song et al, 2008]

3.5. DM based on idea by domain driven design

DM based on idea by domain driven design is new technique and method for inheriting veteran TCM doctor. The disadvantage of general DM consists in mining only the separate part of expert's thoughts and mining too much uninteresting and not actionable knowledge. At the same time DM is too difficult to analyze and find the law existed in the complex data, which also amounts to a huge number. The main disadvantage of master-disciple method consists in depending too much on the master's wisdom and capacity. The inheriting method also will be facilitated to wide people with difficulty. So we stand for the combination of DM and the usage of expert's thoughts, wish to develop DM based on idea by domain driven design[Zhu, Gu, 2008, Zhu,Gu,et al, 2008].

3.6. Research type of master-disciple method

Research type of master-disciple method is an innovation compared with the old master-disciple method. Traditional master-disciple method is a good method for inheriting veteran TCM doctors, but it also meet with some new problems, such as how can to collect and store a huge amount of clinical evidences, with difficulty to compare own master with other masters experiences etc. So we must to explore new kind of master-disciple method. The research type of master-disciple method is based on the traditional master-disciple method, take the management like project, combine the research on traditional TCM method and modern medical and natural science, combine the master and computer. The flowchart of research inheritance is been designed [see Figure 5]

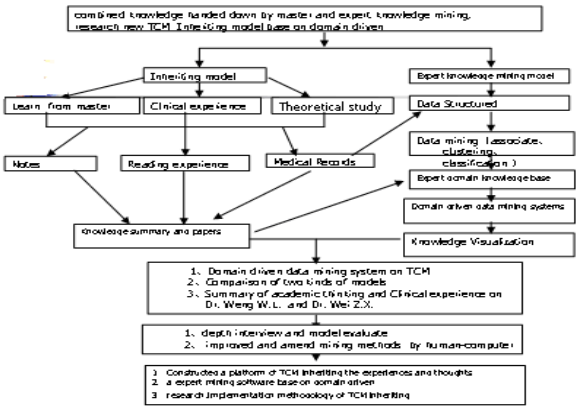

Figure 5. Flowchart for research inheritance

IV. SOME EXAMPLES FOR USING SOME EM AND THE KNOWLEDGE MINED BY THEM

Our project has collected some knowledge from some veteran tcm doctors. For example we extract some domain knowledg during use the data mining (see figure 6) and integrate them into mined knowledge (see figure 7). By using the bipartite graph method to compare the treating method by different doctors (see figure 8 and table 1). Finally we use the network analysis to find the features for dialectic healing by different doctors (see Figure 9).

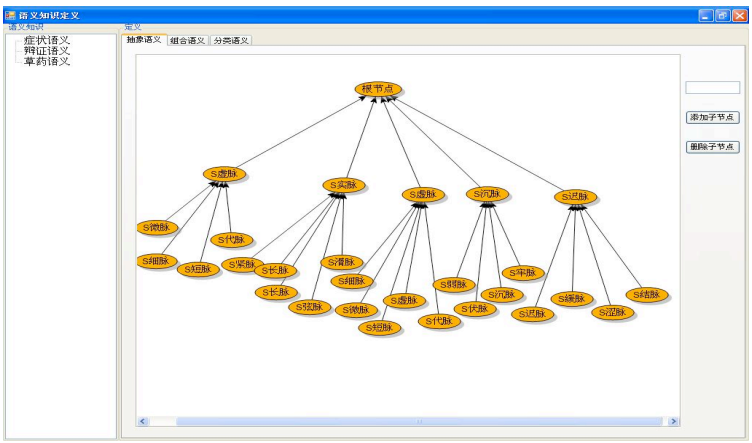

Figure 6. Extraction of domain knowledge

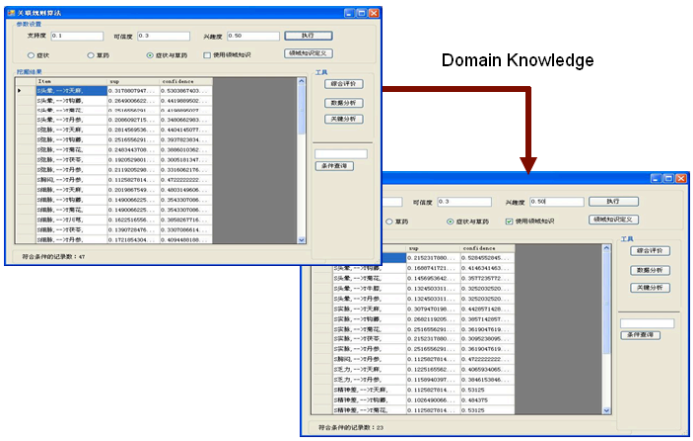

Figure 7. The result of integrating the domain knowledge

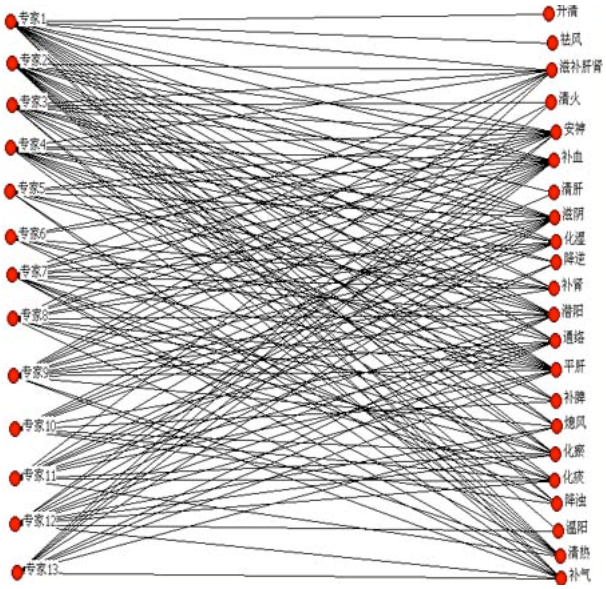

Figure 8. Expert-keyword model based on bipartite network

Table 1. Thinking similarity of experts

	专家1	专家2	专家3	专家4	专家5	专家6	专家7	专家8	专家9	专家10	专家11	专家12	专家13
专家1	0.2267	0.0928	0.091	0.0933	0.0992	0.1117	0.102	0.0912	0.0988	0.0933	0.0766	0.0725	0.0868
专家2	0.0873	0.1669	0.0648	0.0786	0.0973	0.1118	0.1036	0.0766	0.0905	0.1221	0.0787	0.1238	0.0864
专家3	0.0696	0.0527	0.1379	0.0926	0.0797	0.0457	0.0749	0.0911	0.0918	0.0633	0.0889	0.0717	0.0943
专家4	0.0713	0.0639	0.0926	0.1275	0.0665	0.0452	0.0674	0.0858	0.0783	0.078	0.1014	0.0874	0.078
专家5	0.0467	0.0487	0.0491	0.0409	0.1035	0.0538	0.0608	0.045	0.0595	0.0168	0.0372	0.0412	0.0505
专家6	0.046	0.0489	0.0246	0.0244	0.0471	0.12	0.0522	0.0285	0.0379	0.0509	0.03	0.0346	0.0316
专家7	0.078	0.0841	0.0749	0.0674	0.0887	0.0969	0.1168	0.0897	0.0791	0.078	0.0807	0.0624	0.0611
专家8	0.059	0.0526	0.0771	0.0726	0.0619	0.0448	0.0759	0.1115	0.0554	0.079	0.0714	0.0614	0.0609
专家9	0.0755	0.0736	0.0918	0.0783	0.0966	0.0704	0.0791	0.0655	0.1289	0.0416	0.0695	0.0646	0.1208
专家10	0.0494	0.0687	0.0438	0.054	0.0189	0.0654	0.054	0.0646	0.0288	0.1723	0.057	0.0419	0.0249
专家11	0.0496	0.0541	0.0753	0.0858	0.0512	0.0471	0.0683	0.0714	0.0588	0.0697	0.1192	0.0749	0.0525
专家12	0.0512	0.0929	0.0662	0.0807	0.0619	0.0593	0.0576	0.067	0.0597	0.0558	0.0817	0.1515	0.0785
专家13	0.0511	0.054	0.0725	0.06	0.0631	0.0451	0.047	0.0553	0.093	0.0277	0.0477	0.0654	0.1259

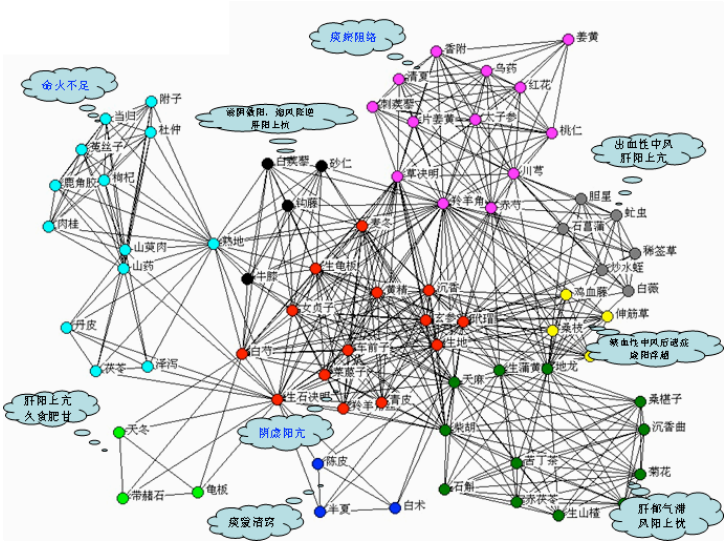

Figure 9. Dr.103’ s features for dialectic healing by network analysis

VI. CONCLUSION

This research is trying to use the combination of the old tradition of teaching by master personally and expert mining to explore the experiences and thoughts from famous elder TCM doctors. Thus the final aim is to inherit the experiences and thoughts from one side, from the other side is to form the new relationship between teacher and students and new master-disciple education method for inheriting the TCM.

VII. Acknowledgment

From 2006 we had participated into a large project under Ten-five year state plan supported to S&T sponsored by Ministry of Science and Technology, then continued to join similar project under Eleven-Five year state plan supported to S&T (2007BAI10B06-05). The purpose of this large project was designed for collecting and maintaining the idea, experiences, knowledge and wisdom from 100 elder and famous experts in TCM. Here the experts are veteran TCM masters. We wish mine the main ideas and experiences for each of them and wish also to find their collective experiences and thoughts.

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