Original Article
Current situation of learning style of Chinese medical undergraduates and its consideration

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Abstract: Researches of learning style have started late in China and those on medical students have been seldom reported. Still the results and conclusions with the samples of the western counterparts were not suitable for them due to different educational and cultural backgrounds. All 2207 students in some medical university in China were surveyed with the inventories of Visual, Aural, Read/Write, Kinesthetic questionnaire (VARK), Myers-Briggs Type Indicator (MBTI), and Kolb Learning Styles Inventory (KLSI) in June, 2014 and 2098 valid results were collected (95.1%). The results showed that: (1) The students, especially the males, mainly had multiple learning styles (57.5%). Those with treble-tendency or R type had better achievements. (2) The most common personality types were Extroversion-Sensing-Thinking-Judging (ESTJ, 14.1%), Introversion-Sensing-Thinking-Judging (ISTJ, 11.8%), Introversion-Intuition-Feeling-Perception (INFP, 11.7%) and those with Extroversion-Intuition-Feeling-Perception (ENFP), Introversion-Sensing-Thinking-Perception (ISTP), Introversion-Sensing-Feeling-Perception(ISFP) and Extroversion-Intuition-Feeling-Judging (ENFJ) had better achievements. (3) Most of them belonged to diverging type (73.2%) and those with converging type had better achievements and motivations. (4) It showed statistical significance between the distribution of Kolb styles and the distribution/tendency quantities of VARK (χ^2=41.782, 26.525, P<0.001, =0.002). There are both similarities and differences of learning styles between Chinese and Western medical students. The majority of personality type should be regarded as "typical personality"; while the type corresponding to excellent achievements could be "advantageous personality". The physiological factors of learning style might be related to the psychological factors.

Keywords: Visual, Aural, Read/Write, Kinesthetic questionnaire (VARK), Myers-Briggs type Indicator (MBTI), Kolb learning styles inventory (KLSI), medical students, learning style

Introduction

Learning style, always concerned by school psychologists, belonged to the issues of individual differences and had significant application value in the effectively implementing aptitude education. Knowing individual learning style is both helpful for students to take effective measures to improve learning effect and for teachers to moderate the teaching contents and adopt more appropriate teaching style [1].

Up till now, there are more than 30 famous theoretical models on learning style, based on which over 70 kinds of inventories [2] were developed, including *KLSI* developed by David Kolb at the beginning of 1980s based on the *learning circle theory* and *experience learning style type*; Neil Fleming's *VARK* (*the Visual, Aural, Read/Write, Kinesthetic questionnaire*) [3] focused on how to use sense organs to effectively learn; *MBTI* (Myers Briggs Type Indicator) model developed by Myers and McCaulley [4] on the basis of Swiss scholar Carl Jung's Introverted and Extraverted Personality Theory. Many researches focused on the distribution of students' learning style or comparing the differences in different genders or specialties with single inventory.

Among various specialties, medicine is undoubtedly special because practice plays a very important role in cultivating medical students. Then, does learning style have the special significance for this specialty? As a country which owns the largest number of medical students in

the world, however, China's learning style focusing on medical students was rarely studied, the reason for which could be attributed as two mainly parts. First, the researches of learning style in China have started since late 1990s, and initially focused on the introduction of the given results from the western countries, the field primarily covered economic management, geography, and so on, scarcely medicine or its corresponding population. Second, the situation where the results should be applied to was quite a diffident case between Chinese and western medical students due to utterly different educational & cultural backgrounds, household financial conditions and traditional modes of thinking.

There are several categorizations of learning style, among which the five taxonomy system invented by Rebecca Oxford was more typical. This article investigated the students in one Chinese medical university with 3 widely-used assessment tool with high reliability and directive significance to teaching, including *VARK* which belonged to the first type of learning style---related to the preference of sense organ and fell into the physiological element, *MBTI* which belonged to the second type of learning style---related to the personality features and fell into the psychological element, *KLSI* which studied learning process and contained the third, fourth and fifth types of learning style----related to the ways of information process, reception and thinking model and fell into the psychological element. We hope that, by conducting such a survey followed by statistical analysis, a comparison between Chinese and western medical students on learning styles could be made and an in-depth correlation would be probed too, followed by a reasonable possibility of more scientific and effective introduction on the same object in the future.

Methods

Participants

The "3+2" education system was implemented in the surveyed Chinese medical university, i.e., (theoretical learning for three years and clinical practice for two years). Since most of the students in fourth and fifth grades were distributed to practice medicine in different teaching hospitals across the country, the participants only included the freshmen, sophomores,

juniors. All 2207 students on campus were surveyed with the questionnaires of VARK, MBTI and KLSI in June, 2014 and 2098 valid results were collected (95.1%), including 1788 male and 310 female; the freshmen 726, the sophomores 845 and the juniors 636. The demographics of our study group included a range of 15-27 ages, average 20.67±1.652 years.

Data collection

All questionnaires were filled properly before a specific introduction was made in advance. The questionnaires included the following parts:

VARK (the Visual, Aural, Read/Write, Kinesthetic) questionnaire 7.0 version: It consisted of 16 multiple choice questions, and each had four choices (respectively corresponded to the four senses), which the students could select one or more. The English version of VARK was translated and the validity was approved that its Cronbach's alpha coefficient was 0.86 [5].

MBTI (Myers-Briggs Type Indicator, Chinese Form G): Form G was revised in 1987 in Psychology Department in American East Carolina University and contained 126 items [5]. However, the Chinese version of MBTI (Form G) was then developed and abbreviated into 94 items, including 21 Extroversion-Introversion (E-I), 26 Sensing-Intuition (S-N), 23 Thinking-Feeling (T-F) and 24 Judging-Perception (J-P). Its reliability and validity were similar to the western version [6] while each item had two choices as well. It measured four dimensions, i.e., E-I, S-N, T-F and J-P which separately described main energy source and attention direction in teaching, the way to collect information and thinking tendency, the way when making decisions or judging, and the lifestyle that individuals preferred to (planned or improvised). Each letter represented one of the two preferences in each dimension; the combination of the letters on these 4 dimensions shaped 16 personality types.

KLSI (Kolb Learning Styles Inventory) 3.1 version: It consisted of 12 questions; each described one learning situation and was attached with 4 choices to randomly present the four-phase with head-to-tail connection including "Active Experimentation (AE)", "Abstract Conceptualization (AC)", "Reflective Observation (RO)" and "Concrete Experience

Table 1. Comparison of tendency distributions of VARK learning style in Chinese medical students

Student groups	Single N (%)	Double N (%)	Treble N (%)	Quadruple N (%)	χ^2	P
As a whole	887 (42.5)	373 (17.9)	262 (12.5)	567 (27.1)	430.566	<0.001
Different Genders						
Males	733 (41.2)	319 (17.9)	227 (12.8)	500 (28.1)	9.059	0.029
Females	154 (49.7)	54 (17.4)	35 (11.3)	67 (21.6)		

(CE)" during the learning process [7]. Based on the results, 4 main variables (CE, AC, AE and RO) and 2 combined variables (the dimension of grasping information---AC-CE, which meant one preferred to his own "feeling" or the abstract way; the dimension of transferring information/process----AE-RO, which meant one preferred to apply knowledge directly or judge after making careful observation) were calculated. After contrasted with the learning-style type grid attached to LSI, the corresponding point on the coordinate was found based on the scores of the variables and the learning style of every participant was finally determined whether converging (learning capacities were mainly AC and AE), diverging (CE and RO), assimilating (AC and RO) or accommodating (CE and AE). Its reliability and validity remained above moderate, and the lower coefficients were 0.70 for Cronbach's alpha and 0.54 for test-retest reliability of the six variables [7].

The Simple Assessment Inventory for College Students' Learning Motivations: It consisted of 12 questions with high reliability and validity (Alpha coefficient was 0.79, and internal consistency reliability was 0.85) [8]. Based on the scores, the strength of the learning motivation was divided into three types, i.e., strong, intermediate and weak type. We analyzed the results as the quantitative data (the weak level=1; the intermediate level=2; the strong level=3) in our survey.

Grade Point Average (from students' archives in the university). The management provisions of the university classified the students' Grade Point Averages as four levels: excellent (90-100 scores), good (80-89 scores), intermediate (70-79 scores) and bad (less than 69 scores). According to the student ID filled in the questionnaire, the corresponding Grade Point Average was found in the students' archives, which was regarded as the quantitative data (the poor level=1; the moderate level=2; the good level=3; the excellent level=4) in our survey.

Ethical considerations

In China ethical approval of medical education research has not yet required to be recorded or documented. However, we elaborately discussed the purpose and design of the survey with the teaching faculty and two senior officers engaged in education management in the university. They were supposed to make sure all the subjects who voluntarily participated in this survey were well informed in advance. We considered the return of a completed questionnaire to represent the provision of informed consent.

Statistical analysis

We invited two men to input and check the data twice with EpiData3.1 software. We used chi-square test for categorical data, and variance analysis and SNK test for quantitative data by the statistical software package-SPSS 20.0.

Results

VARK part

VARK inventory has divided learning styles into single one and multiple ones. The multiple ones were also divided into double-, triple- and quadruple-tendency, which also named double, triple and quadruple learning styles. According to the dichotomous approach, the participants with multiple styles (57.5%) were more than those with single style; according to the quartering approach, the participants with single style were all more than those with double, triple and quadruple learning styles (**Table 1**). The proportion of single style was higher in the female students than that in the male students; but the proportion of multiple ones was on the contrary. In those with single style, K type came first (41.4%) and V type occupied the least (8.3%); R (24.9%) was similar to A (25.4%) which both ranked in the middle. There was no statistic difference between the male students and the female students (χ^2=7.847, P=0.050).

Table 2. Comparison of the achievements of Chinese military medical students with different personality type

Person-ality Type	Grade Point Average				χ^2	P
	Excellent N (%)	Good N (%)	Moderate N (%)	Poor N (%)		
ESTJ	43 (14.5)	136 (45.9)	84 (28.4)	33 (11.1)	73.610	0.005
ESTP	6 (11.5)	24 (46.2)	17 (32.7)	5 (9.6)		
ESFJ	23 (13.5)	87 (51.2)	46 (27.1)	14 (8.2)		
ESFP	15 (16.1)	35 (37.6)	26 (28.0)	17 (18.3)		
ENTJ	16 (20.8)	28 (36.4)	22 (28.6)	11 (14.3)		
ENTP	3 (11.1)	11 (40.7)	7 (25.9)	6 (22.2)		
ENFJ	17 (19.8)	31 (36.0)	36 (41.9)	2 (2.3)		
ENFP	26 (22.8)	46 (40.4)	34 (29.8)	8 (7.0)		
ISTJ	35 (14.1)	95 (38.3)	94 (37.9)	24 (9.7)		
ISTP	15 (22.4)	28 (41.8)	21 (31.3)	3 (4.5)		
ISFJ	21 (15.1)	61 (43.9)	39 (28.1)	18 (12.9)		
ISFP	22 (21.8)	39 (38.6)	30 (29.7)	10 (9.9)		
INTJ	19 (13.0)	67 (45.9)	49 (33.6)	11 (7.5)		
INTP	23 (27.7)	25 (30.1)	18 (21.7)	17 (20.5)		
INFJ	25 (16.3)	64 (41.8)	47 (30.7)	17 (11.1)		
INFP	41 (16.7)	109 (44.5)	74 (30.2)	21 (8.6)		

The quantity of tendencies of VARK was found no statistically difference from the intensity of learning motivations (F=0.600, P=0.615), but difference from Grade Point Average (F=3.890, P=0.009). Further SNK test showed that those with treble-tendency had better achievements (2.77) than those with quadruple-tendency (2.56), and those with single (2.68) or double styles (2.63) were not different from others. The distribution of single learning style was found no difference from Grade Point Average (F=1.866, P=0.114); still different from learning motivations (F=4.155, P=0.002), and further SNK test showed that those with R type had higher motivations (2.08) than those with K (1.88) type, but those with A (1.95) or V (2.00) was not different from others.

MBTI part

In our survey Introversion (I, 56.4%), Sensing (S, 55.6%), Feeling (F, 52.5%) and Judging (J, 62.7%) were favored by most of the participants in the 4 dimensions. The females were different from the males only in Extroversion-Introversion (E-I) dimension (χ^2=4.321, P= 0.038) that their proportion of E was higher (49.0% versus 42.7%).

The most common personality types of the participants were Extroversion-Sensing-Thinking-Judging (ESTJ, 14.1%), Introversion-Sensing-Thinking-Judging (ISTJ, 11.8%), and Introversion-Intuition-Feeling-Perception (INFP, 11.7%) (all more than 10%), followed by Extroversion-Sensing-Feeling-Judging (ESFJ, 8.1%), Introversion-Intuition-Feeling-Judging (INFJ, 7.3%), Introversion-Intuition-Thinking-Judging (INTJ, 7.0%), Introversion-Sensing-Feeling-Judging (ISFJ, 6.6%), Extroversion-Intuition-Feeling-Perception (ENFP, 5.4%), Introversion-Sensing-Feeling-Perception (ISFP, 4.8%), Extroversion-Sensing-Feeling-Perception (ESFP, 4.4%), Extroversion-Intuition-Feeling-Judging (ENFJ, 4.1%), Introversion-Intuition-Thinking-Perception (INTP, 4.0%), Extroversion-Intuition-Thinking-Judging (ENTJ, 3.7%), Introversion-Sensing-Thinking-Perception (ISTP, 3.2%), Extroversion-Sensing-Thinking-Perception (ESTP, 2.5%) and Extroversion-Intuition-Thinking-Perception (ENTP, 1.3%), which showed significant differences between the male students and the females (χ^2=28.203, P=0.020). Detailed analyses demonstrated that all personality types were different between them. Taken the types with more than 5% for example, the percentage of ESFJ of the females (8.4%) was higher than that of the males (8.0%) (χ^2=81.000, P<0.001); the percentages of ENFP, ISTJ, INTJ, INFJ and INFP of the females (3.5%, 9.0%, 5.2%, 6.5%, 10.0%) were lower than those of the males (5.8%, 12.3%, 7.3%, 7.5%, 11.9%) (χ^2=74.246, 148.645, 89.014, 83.458, 135.754, P<0.001).

It showed statistical significance in the intensity of learning motivation among the 16 personality types of the participants (F=1.879, P=0.021). SNK test further showed that the intensity of those with ENFP type (2.09) was higher than that of those with INTP (1.77); it showed no statistical differences of the intensity among those with other personality types.

It showed statistical significance in Grade Point Average among the 16 personality types of the participants (**Table 2**). In our survey the personality types with excellent achievements were deduced from both the distribution of Grade Point Average of the students with different personality types and the gaps between the

Table 3. Comparison between the type of Kolb learning style and distributions of VARK learning style

Type of Kolb Learning Style	Distributions of VARK Learning Style					χ^2	P
	Multiple N (%)	V N (%)	A N (%)	R N (%)	K N (%)		
Diverging	896 (58.6)	58 (3.8)	163 (10.7)	154 (10.1)	257 (16.8)	41.782	<0.001
Assimilating	170 (51.2)	12 (3.6)	43 (13.0)	56 (16.9)	51 (15.4)		
Converging	59 (65.6)	0 (0.0)	7 (7.8)	1 (1.1)	23 (25.6)		
Accommodating	78 (55.3)	4 (2.8)	13 (9.2)	10 (7.1)	36 (25.5)		

proportion of excellent achievements and that of bad achievements. It can be seen from **Table 2** that although the proportion of ESTJ of the participants was higher in the 16 types, most of them belonged to good achievement (45.9%), followed by intermediate, excellent and bad achievements. Therefore, ESTJ did not belong to the type with good achievement. The personality types of ESTP, ESFJ, ENTJ, ENFP, ISTJ, ISTP, ISFJ, ISFP, INTJ, INFJ and INFP were similar, whose distributions of achievements generally appeared like this: Good > Intermediate > Excellent > Bad. The type of ENFP was the "advantageous" type because its proportion of "Excellent" was higher (22.8%); while the proportion of "Bad" was the lowest (7.0%). The situations of ISTP and ISFP were similar, and their proportions of "excellent" were higher (22.4% and 21.8%) while those of "bad" were lower (4.5% and 9.9%). The percentage distribution of achievement of the students with ENFJ type was like this: Intermediate > Good > Excellent > Bad, and its proportion of "excellent" was higher (19.8%) while that of "bad" was the lowest (2.3%). Therefore ENFJ type belonged to "advantageous" type. Besides, although the "excellent" proportion in ESFJ was not high (13.5%), its proportion of "good" was higher (51.2%) and that of "bad" was lower (8.2%). Therefore, ESFJ type was the "advantageous" type. The distributions of those students with ESFP or ENTP type was like this: Good > Intermediate > Bad > Excellent, and the proportion of Bad achievement was even higher than those of excellent; the situation of INTP was like this: Good > Excellent > Intermediate > Bad, the distribution was more even and the percentage difference was unapparent. Therefore these two types didn't belong to the personality types corresponding to good achievement. In all 16 types we didn't see the phenomenon that the proportion of "excellent" was the highest. It can be concluded that the students with ENFP, ISTP, ISFP and ENFJ types had better achievements although the superiority was not obvious.

KLSI part

There were 1535 participants who belonged to the diverging type (73.2%), 332 the assimilating type (15.8%), 90 the converging type (4.3%) and 141 the accommodating type (6.7%). It showed no statistical difference between the male and female students (χ^2=1.432, P= 0.698).

It showed statistical significance among the intensities of learning motivations with different Kolb learning styles (F=3.437, P=0.016). SNK test further showed that the learning motivation of the students with converging type (2.14) was higher than that with assimilating (1.94) or diverging type (1.96), while that with accommodating type (2.04) was not different from the others. It showed no statistical difference among the levels of achievements of the students with different Kolb learning styles (F=2.102, P=0.098). However, SNK test showed that the achievement of those with converging style (2.86) was better than that with assimilating style (2.60), while that with diverging type (2.65) or accommodating type (2.69) was not different from the others.

The relation between Kolb learning style and VARK learning style

It showed statistical significance between the distribution of Kolb learning style and that of VARK learning style (**Table 3**). The multiple learning styles were dominant in number in each type of Kolb learning style especially in the converging style (65.6%). We observed few "V" type among those with the converging type. The proportion of "K" type was relatively higher in those who belonged to the converging and accommodating styles (25.6% and 25.5%). The proportion of "R" type was relatively higher in those belonged to the assimilating style (16.9%).

Table 4. Comparison between types of Kolb learning style and tendencies of VARK learning style

Type of Kolb Learning Style	Tendencies of VARK Learning Style				χ^2	P
	Single N (%)	Double N (%)	Treble N (%)	Quadruple N (%)		
Diverging	632 (41.4)	260 (17.0)	191 (12.5)	445 (29.1)	26.525	0.002
Assimilating	162 (48.8)	61 (18.4)	33 (9.9)	76 (22.9)		
Converging	31 (34.4)	24 (26.7)	19 (21.1)	16 (17.8)		
Accommodating	63 (44.7)	29 (20.6)	19 (13.5)	30 (21.3)		

It showed statistical significance between the types of Kolb learning style and the tendency quantities of VARK learning style (**Table 4**). The proportions of single learning style, quadruple-tendency, double-tendency and triple-tendency were separately the highest in those with assimilating styles (48.8%), those with diverging styles (29.1%) and those with converging styles (26.7%).

The 16 personality types of MBTI were all different from the types of Kolb learning style (χ^2=177.526, P<0.001), the distribution (χ^2=41.782, P<0.001) and tendency quantities of VARK (χ^2=12.517, P=0.186). Further detailed comparison between MBTI and other two inventories were not compared because of a large number of personality types of MBTI.

Summary of main endings

Chinese medical students mainly have multiple learning styles (57.5%), especially in the male students. Those with treble-tendency or R type had better achievements. The most common personality types were ESTJ (14.1%), ISTJ (11.8%), INFP (11.7%) and those with ENFP, ISTP, ISFP and ENFJ had better achievements. Most of them belonged to diverging type (73.2%) and those with converging type had better achievements and higher motivations. It showed statistical significance between the distribution of Kolb styles and the distribution/orientation quantities of VARK (χ^2=41.782, 26.525, P<0.001,=0.002).

Discussion

The similarities and differences of VARK learning styles between medical students in China and those in western countries

In our survey most of Chinese medical students belonged to multiple learning styles, which was similar with the western ones whose multiple learning styles occupied nearly 2/3 [9, 10] or 59% [11]; such feature was more obvious in the male students, which was contrary to the western counterparts that the female students had more multiple styles [9, 10]. As to the single learning style, the proportion of K was the highest and that of V was relatively the lowest, which was different from the western ones among whom A type came first and of course was more than K type [9-11]. Learning styles of Chinese medical students were indeed different from those of western ones with different educational conditions, cultural atmospheres and teaching methods.

Besides, K type, according to the features of Medicine with strong practice, was very important in the process of learning medical knowledge and helpful for medical students to complete the practice task outstandingly [10, 11]. The more K type in Chinese medical students might prove that they have more adaption to Medicine than the western ones.

In our survey the students belonged to R type had higher motivation than those who belonged to K type. R type should be suitable for Chinese traditional teaching in which theory teaching and reading were centered on; and the ill-adaption for a long time of those with K type might lead to the reduction of their learning motivation.

It was reported that multiple learning styles were more beneficial to learning than single style [11, 12]. However, the inconsistent conclusion was drawn from our survey that triple learning style tended to be more beneficial to improve achievement for medical students. Maybe the students tended to lose their advantages and get poor results if they referred to too many channels during the learning? The concrete shaping mechanism needs to be further explored.

The similarities and differences of MBTI personality types between medical students in China and those in western countries

Our survey revealed that when receiving information, most of Chinese medical students preferred to acquire concrete information with sense organs (S) and make assessment with the individual standards (F); their mental energies were towards inner world (I) (all more than 50%); and they liked regular life and learning (J) (62.7%), which was contrary to the western ones who favored E, S and J [4]. In our survey ESTJ, ISTJ and INFP were the most common personality types of Chinese medical students (all more than 10%), among which ISTJ and INFP were more in the male students than in the female students. It was reported that the most common personality types of medical students in England were ESFJ, ESTJ, ENFJ and ENTJ (more than 79%) [4], those in America were ISTJ, ESTJ, ESFJ and ISFJ [13], and those in other western countries were ISTJ, ESFJ, ESTJ and ISFJ [14]. Both Chinese medical students and the Western ones preferred S and J but the Chinese ones preferred more Introversion (I) to Extroversion (E) than their English counterparts. This was an interesting and not unexpected result. E may be more competitive, expressive and open-minded, while I tends be quiet and more contemplative. In Western culture, students were encouraged to openly express their own opinions and be independent [4], while in oriental countries especially in China, individuals were instructed to obey their elders' words and to be unpretentious, which resulted in their introspective, quiet and conservative personalities.

Though there was no good or bad for every personality type, many articles reported that some personality type concentrated on the students majored in some specialty and put correspondingly forward the concept of "advantageous personality". These researches included two kinds: one was to directly analyze the distribution of personality type of the excellent students. For example, Cross, Neumeister, and Cassady surveyed on 931 excellent teenagers and found that the most common types were INTJ, INTP, INFP, ENFP, and ENTP and most of them preferred to N and P [15]. Klos, Noyimeister, and Kaysadie drew the similar conclusion that the most common types were INTJ, ENFP, INTP and INFP among 924 excellent

students and deduced that P and N were beneficial to academic performance [16]. The other was to compare the same group to search for the personality types corresponded to the better academic performance. For example, Ziegert found that the students majored in economics with the favor of N and T performed better than those with the favor of S and F [17]. A series of researches completed by 8 colleges and CAPT (Center for Applications of Psychological Type) concluded that the students majored in engineering with the favor of I, N, T and J performed better than those with the favor of E, S, F and P [18]. So the personality types with the largest number have not been separated from the types corresponding to better academic performance and were both called "advantageous style", which make the two concepts of the superiority of quantity and the dominant of achievement confused. We thought that the majority of personality type in some group should be regarded as their "typical personality"; while the type corresponded to excellent achievements/performances could be their "advantageous personality".

Was the typical personality equal to the advantageous personality? In our survey ESTJ, ISTJ and INFP were the typical personalities of Chinese medical students (14.1%, 11.8%, and 11.7% respectively), which was totally different from the advantageous types, which included ENFP, ISTP, ISFP and ENFJ. Those with ENFP should be firstly considered under the same situation when selecting applicants because of the highest learning motivation. In the present system in China, the information available to aid in the selection of students for colleges depends heavily on the applicants' scores on the annually National College Entrance Examination (NCEE), which does not take into account their personality types and interests. Most of them knew little about the colleges and the majors. They just chose the college under the "guidance" of their parents, and what they considered was only whether the majors were "hot" and had good development prospect. Our survey result also provided the reference for Chinese medical colleges to scientifically select entrance students. It was reported that N and P were the preferences of the western excellent medical students, which was also different from Chinese medical students in that the preference of N and P was both observed in those with the strongest learning motivation and

those with the weakest motivation in our survey.

The similarities and differences of Kolb learning styles between medical students in China and those in western countries

In our survey diverging type was the dominant learning style of Chinese medical students (73.2%), followed by assimilating style (15.8%), and the proportions of other styles were lower, which was no difference between male students and female students. Still the assimilating type and converging type were the most common in western medical students [19, 20]; most of the males belonged to the converging and accommodating types and most of the females belonged to the assimilating and diverging type [21].

Medicine is a major with the stronger characteristic of practice, which requires the students to have good operational ability and continuously accumulate experience in medical practice. It seemed that those with the diverging type didn't match with Medicine because they preferred feeling and observation to hands-on experience [22]. Those with the converging type were good at combining theory with practice, which attached importance to the practical application of medical knowledge [22]; they preferred to think through the detailed and sequential steps, which was helpful to judge the patients' condition and making correct decision in the clinical practice. Therefore those with the converging type matched Medicine more and might be the dominant type, which was demonstrated from our survey that they had higher learning motivation/better academic performance than the others. Besides, the students with the assimilating type were good at observation, conclusion and logical thinking, and therefore they were suitable to do medical research in future. Of course, those with the converging type were not good at interpersonal skills, which were disadvantageous to medical students to communicate with the patients and their family members in future clinical practice, but it was not foremost.

The relations between different kinds of learning styles-take Kolb and VARK for example

Most of learning style models and inventories focused only on one aspect, but in fact differ-

ent inventories may be associated. For example, Pask demonstrated that the whole-sequence style was related to converging-diverging styles because the diverging style was related to the field independence style [23]. Since different inventories divided learning styles from different dimensions or viewpoints, survey with different inventories at the same time had not only positive promotion on comprehensively understanding students' learning styles but also certain significance in seeking for the correlations among the influence factors of learning styles.

The results of Kolb learning style were related with those of VARK in our survey. For example, most of the participants with the converging style belonged to multiple learning styles; among them no one was V type and more were K type. Those with the assimilating style mainly belonged to the single style, among them most were R type; those with the diverging style mostly belonged to the quadruple learning style, and so on. This result may show that the sensory preferences of individuals were related to their learning process. It can be deduced that the physiological factors of learning style are related to the psychological factors, and the two factors are coexisted and can't be separated. Our survey was also an attempt in exploring the relations between different inventories/contributory factors of learning style.

Conclusion

There are both similarities and differences of learning styles between Chinese medical students and the Western counterparts. The majority of personality type should be regarded as "typical personality"; while the type with excellent achievements could be "advantageous personality". The physiological factors of learning style may be related to the psychological factors.

The significance of this study

This article surveyed on Chinese medical students who accounted for a large proportion of medical students all over the world with several inventories of learning styles and found their learning styles were different from the western ones, which provided a reference for medical educators in China and foreign countries. This article also distinguished the styles which occu-

pied the majority from those with excellent performance, and named them respectively "advantageous type" and "typical type". Finally this article compared the relations between VARK and KLSI, which suggested a potential link between different contributory factors of learning styles.

Notes on contributors

JL conducted the detailed questionnaire survey and composed the article. JH performed the analysis of the data and approved of the final version to be published; JF, and LZ assisted in composing the manuscript; MMM, KS and JS made substantial contributions to conception and design.

CM drafted the article or revised it critically for important intellectual content, responsible for the design of the study.

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Disclosure of conflict of interest

None.

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