Metacognitive Awareness of Third-Year Chinese Undergraduate Pharmacy Students in Wuhan University of Science and Technology: Preliminary Evaluation and Implications for Training of Life-long Learners

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ABSTRACT

Background: Assessing and improving metacognitive awareness in pharmay students is essential to maintain lifelong competency of pharmacists and high-quality care for their patients. **Objective:** This preliminary study aimed to investigate the acquisition of metacognitive awareness and self-assessment as a predictor/estimator of scores on a summative examination in 57 third-year Chinese undergraduate pharmacy students in Wuhan University of Science and Technology. **Methods**: The 30-item Meta-cognitions Questionnaire (MCQ-30) was used to assess students' metacognitive beliefs. Before administration of examination, students were required to complete a percentage correct scale for self-quantifying their potential performance, and students were also provided estimates of their performance after completing the examination. **Results:** The mean score of MCQ-30 was 76.95, and there were no significant differences in MCQ-30 scores according to gender and age, except that males scored 2.03 points higher than females in the "Need for control over thoughts" subscale. However, only 33.3% of students correctly predicted their total scores before exam, and the differences between actual and estimated performance after exam were statistically significant. In general, respondent pharmacy students have under-predicted their performance before the exam, but over-estimated their performance after exam. Moreover, students who accurately or under-predicted their performance before exam had higher MCQ-30 scores than over-predicted students. **Conclusion:** It is necessary to explore effective educational methods to help Chinese pharmacy students to practically develop metacognitive awareness and skills by creating awareness of their existing knowledge.

Key words: Metacognitive awareness, Pharmacy education, China, 30-item meta-cognitions questionnaire, Life-long learning, Assessment.

INTRODUCTION

Development of life-long learning orientations for creating life-long learners is a key issue for the creation of a global knowledge society.[1] Especially for pharmacists, the life-long learning process has become a professional obligation, to accommodate rapidly changing and growing pharmaceutical knowledge, continuous new drug research and development.[2] Creating life-long learning principles in students which will last beyond graduation day is believed critical in ever-changing academic fields including pharmacy.[3] The current reforms in Chinese pharmaceutical undergraduate education are emphasizing the need for life-long learning skills for the pharmacy graduate.[4] Enabling pharmaceutical students to be active, self-directed, life-long learners is one of important education goals of undergraduate curriculum in China.

As a key component of life-long learning, meta-cognition has attracted increasing research interest in the higher education domain due to its key role

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in increasing academic success.[5-7] Meta-cognition is first offered by Flavell[8] and described as a learner's knowledge of their own cognition. The main components of meta-cognition have been known as "knowledge of cognition" (metacognitive awareness) and "regulation of cognition" (metacognitive regulation).[6] Thereinto, metacognitive awareness, which refers to an individual's self-awareness of his own cognition and previously learned information as a cognitive processor, is a necessary and foundational aspect of meta-cognition.[5] Promoting meta-cognition begins with building an awareness among learners on their own learning experience. Developing knowledge of cognition allows learners to be aware of what they know, then focus on learning what they do not know, thus enable learners to monitor their cognitive processes.

Evaluating students' ability to predict/estimate their performance on examinations is a simple and common way of measuring metacognitive awareness in education field.[5,9] From a neuropsychological perspective, prediction/estimate has been widely considered as one of important metacognitive skills.[10] Students' prediction/estimate accuracy of their performance may mirror students' awareness of progress on cognitive tasks. Answering an examination question correctly depended on students' recall of information effectively, and judgment of accuracy of that information,[11] demonstrating meta-cognition plays an important role in students' judging the correctness of their answers. Students need to be aware of their strengths and weaknesses as a learner, to be in a position to effectively manage the development of their learning ability. In short, in order to improve performance, students should be able to monitor what they know and what they don't know. Actually, students with high accuracy of prediction/estimate for their performance could assess their level of knowledge adequately and objectively, manage their time and efforts efficiently, and maximize their preparedness for examinations.[5] Whereas, if students lack metacognitive skills and over-estimated their examination performance, they may fail to spend additional time reviewing or studying knowledge, because they believe they have understood adequately,[12] thus would not improved over multiple examinations.[13] Besides, undervaluation could result from low perceived levels of self-efficacy beliefs, manifested as students failing to appreciate their own effort.[14] Students who underestimate their performance would not fully utilize or enhance the knowledge they do possess, therefore their potential efficiencies in learning will be decreased. Therefore, guiding students to achieve greater meta-cognitive awareness and understanding of oneself as a learner has been considered as a useful education tool for training of life-long learners.

The purpose of this study was to investigate the current tate of Chinese pharmacy undergraduates' metacognitive awareness, using the 30-item Meta-cognitions Questionnaire (MCQ-30), a standardized tool in assessing meta-cognitive factors with good reliability and validity,[15,16] coupled with the assessment on the accuracy of their prediction/estimate for performance on a summative examination. In this preliminary study, the MCQ-30 was administered to 57 third-year pharmacy undergraduates at Department of Pharmacy, Wuhan University of Science and Technology, and examined their self-assessment accuracy by comparing actual and predicted/estimated performance on summative pharmacology examination. According to the statistics issued by Chinese Pharmacy Almanac,[4] roughly 19,836 undergraduates were enrolled in all the 49 Chinese pharmacy colleges in 2009. The number of pharmacy students enrolled in Wuhan University of Science and Technology per year was 55-65, which is comparable to and a little more than the average number in China. Moreover, "Pharmacology" offered during the third academic year is one of professional backbone courses for pharmacy undergraduates in China. It has long been considered very important to equip students with 'life-long learning" ability in pharmacology study.[17] Therefore, third-year pharmacy undergraduates at Wuhan University of Science and Technology were selected as the representative of the Chinese pharmacy undergraduate population to preliminarily evaluate the levels of metacognitive awareness. The results could be used to create a reference for educators to implement curricular changes and develop educational guideline for the training of life-long learners with good metacognitive skills.

METHODS

Student participants

The institutional review board of Wuhan University of Science and Technology granted this educational study. Permission was obtained from all students to use de-identified performance assessments for this study and subsequent publications. This study involved 57 third-year pharmacy students (34 female and 23 male under graduates with a mean age of 21.53, SD=0.95) enrolled in Pharmacology (a 18-week, 4.5-credit hour required course) during the autumn and winter 2014 trimester at Wuhan University of Science and Technology.

Instruments: Meta-cognitions Questionnaire-30 (MCQ-30)

The MCQ-30 instrument was used to assess meta-cognitions of pharmacy students. MCQ-30 is a validated, brief self-report consisting of 30 Liker-type items on a 4-point scale (1: do not agree to 4: agree very much) that encompasses 5 subscales: "Positive beliefs about worry"; "Negative beliefs about worry"; "Cognitive confidence"; "Need to control thoughts"; and "Cognitive self-consciousness", which has been confirmed by Cook *et al.*[18] and Olstad *et al.*[19] MCQ-30 scores range from 30 to 120 points and higher scores indicate greater meta-cognitive activity. The Chinese-English bilingual version of MCQ-30 was used in this study to ensure the accurate comprehension of respondents. Questions were also solicited about the students' demographic information, including gender, age and student ID. Estimated time to complete the questionnaire was approximately 10 min.

Performance prediction before exam

Before the administration of the upcoming pharmacology examination, students were required to complete a percentage correct scale for self-quantifying their potential total scores and performance on each of chapters, based on the self-awareness of individual knowledge acquisition. As outlined in the syllabus, the course of pharmacology in this university consists of 6 chapters, including *pandect*, drugs acting on *peripheral nervous*, and *central nervous*, *cardiovascular system*, *other viscera* (such as respiratory, digestive and hematological system) *and endocrine systems*, and *chemotherapy drugs*. Students were asked to "Please predict your percent correct of every chapter on this exam (<50%, 50-70%, 70-90%, or >90%)" and given a maximum of 15 min to complete it.

Performance evaluation after exam

On the other hand, students were asked to provide estimates of their performance after completing the examination. Pharmacology exam administered on the last day of semester was a cumulative assessment of students' knowledge of course content. Seven types of test item were in exam paper of pharmacology, total score of 100 points: "Single Choice" (30 points), "Multiple Choice" (10 points), "Explanation of Terms" (10 points), "Fill in the Gaps" (10 points), "True or False" (10 points), "Short Answer Questions" (18 points) and "Long Essay Questions" (12 points). A question addressing the self-estimates on different types of test item was provided along with the exam paper to complete when the participant checked his/her test paper. This self-estimate was provided on the specific points of each type of test item for self-quantifying their actual performance.

Data analysis

Variance analysis was used to compare the differences of MCQ-30 scores in gender and age using SPSS 14.0. Student predicted/estimated and actual performance was matched. The actual scores were compared with the predicted percent correct of every chapter before exam, or the estimited scores of different types of test item after exam. Data were reported as means ± SD. *p*-value less than or equal to 0.05 was considered to be statistically significant. Chi-square test was used to analyze the differences of the self-assessment accuracy before exam between male and female. In addition, regression and Bland-Altman analysis were used to evaluate the agreement between actual and estimated scores from "Performance evaluation after exam" data using MedCalc software. Bland-Altman analysis involved plotting the differences between actual and predicted performance against their mean. The upper and lower limits of agreement were calculated as bias ± 1.96 times the SD and defined the range in which it is expected that 95% of the differences between actual and predicted performance would lie.

RESULTS

MCQ-30 Scores of Chinese pharmacy undergraduates

Mean scores and standard deviations on the subscales and overall scale are presented in Table 1. The MCQ-30 scores of Chinese pharmacy students ranged from 53 to 101, with a mean of 76.94, a median of 78, and an inter quartile range of 12 (difference between 25th and 75th percentile). There is no significant gender and age difference in MCQ-30 scores, except that males scored 2.03 points higher than females in the "Need for control over thoughts" subscale (p<0.01).

Accuracy of pharmacy students' self-prediction on their performance before exam

Students' actual scores varied substantially with respect to their assessment marks, as shown in Table 2. The comparison of actual total scores versus assessment have revealed that the majority of the students (45.6%) under-predicted their overall examination performance, which demonstrated that most respondents had lower perceptions of their knowlege than their performances indicated before exam. While only a certain proportion (33.3%) of students remained within the predicted percent correct, suggesting they can "gauge" their mastery of material objectively prior to examination. And the remaining (21.1%) undervalued their work. The accuracy

Table 1: Descriptive statistics for MCQ-30 subscales and total scale (means±standard deciations)

Scale	Total sample (n=57)	Male (n=23)	Female (n=34)	Below the age of 21 (n=30)	Above the age of 22 (n=27)
Positive beliefs about worry	18.28 ± 3.05	18.74 ± 2.65	17.97 ± 3.29	18.00 ± 2.85	18.59 ± 3.27
Negative beliefs about worry	12.98 ± 4.08	13.57 ± 3.76	12.59 ± 4.29	13.00 ± 4.09	12.96 ± 4.14
Cognitive confidence	14.42 ± 3.25	14.52 ± 2.73	14.35 ± 3.59	13.87 ± 3.45	15.04 ± 2.94
Need for control over thoughts**	13.79 ± 3.42	15.00 ± 3.09	12.97 ± 3.42	13.47 ± 3.65	14.15 ± 3.17
Cognitive self-consciousness	17.47 ± 2.73	17.74 ± 2.18	17.29 ± 3.06	17.53 ± 3.00	17.41 ± 2.44
Total score	76.95 ± 10.46	79.57 ± 7.45	75.18 ± 11.86	75.87 ± 11.97	78.15 ± 8.54

**$p<0.01$, gender difference is significant.

Table 2: Accuracy of pharmacy students' self-assessment based on the comparison between the actual exam performance and the predicted percent correct

Chapters	Under-predicted	Over-predicted	Within the predicted percent correct
Pandect	36.8% (21/57)	28.1% (16/57)	35.1% (20/57)
Female	44.1% (15/34)	26.5% (9/34)	29.4% (10/34)
Male	26.1% (6/23)	30.4% (7/23)	43.5% (10/23)
Drugs acting on peripheral nervous	7.0% (4/57)	50.9% (29/57)	42.1% (24/57)
Female	5.9% (2/34)	44.1% (15/34)	50.0% (17/34)
Male	8.7% (2/23)	60.9% (14/23)	30.4% (7/23)
Drugs acting on central nervous	66.7% (38/57)	10.5% (6/57)	22.8% (13/57)
Female	70.6% (24/34)	5.9% (2/34)	23.5% (8/34)
Male	60.9% (14/23)	17.4% (4/23)	21.7% (5/23)
Drugs acting on cardiovascular system	66.7% (38/57)	17.5% (10/57)	15.8% (9/57)
Female	67.6% (23/34)	14.7% (5/34)	17.6% (6/34)
Male	65.2% (15/23)	21.7% (5/23)	13.0% (3/23)
Drugs acting on other viscera and endocrine systems	21.1% (12/57)	45.6% (26/57)	33.3% (19/57)
Female	26.5% (9/34)	47.1% (16/34)	26.5% (9/34)
Male	13.0% (3/23)	43.5% (10/23)	43.5% (10/23)
Chemotherapy drugs	19.3% (11/57)	38.6% (22/57)	42.1% (24/57)
Female	29.4% (10/34)	32.4% (11/34)	38.2% (13/34)
Male	4.3% (1/23)	47.8% (11/23)	47.8% (11/23)
Total	45.6% (26/57)	21.1% (12/57)	33.3% (19/57)
Female	47.1% (16/34)	17.6% (6/34)	35.3% (12/34)
Male	34.8% (8/23)	34.8% (8/23)	30.4% (7/23)

of pharmacy students' self-assessment on the mastery of different chapters ranged from 15.8% (*drugs acting on cardiovascular system*) to 42.1% (*drugs acting on peripheral nervous* and *chemotherapy drugs*). Besides, no significant difference was observed between male and female (p-value was 0.924, 0.419, 0.232, 0.870, 0.922, 0.294 and 0.656 in total score, scores of *pandect*, *drugs acting on peripheral nervous*, and *central nervous*, *cardiovascular system, other viscera and endocrine systems,* and *chemotherapy drugs*, respectively).

Accuracy of pharmacy students' self-estimate on their performance after exam

The actual and estimated performance and their differences are presented in Table 3. The mean total score on pharmacology exam for student perception was significantly higher than determined total score by 5.3 points (5.3%) ($p<0.01$). And the differences between actual and estimated performance of 5 types of test item (including Multiple Choice, Explanation of Terms, True

Table 3: Accuracy of pharmacy students' self-assessment based on the comparison between the actual and estimated performance

Type of test item	Total scores (points)	Gender	Estimated Performance	Actual Performance
Single Choice	30		24.1 ± 4.2	23.4 ± 4.6
		Female	25.1 ± 3.6	25.1 ± 3.7
		Male	22.6 ± 4.5	21.1 ± 4.7
Multiple Choice	10		6.0 ± 1.8	4.1 ± 1.9**
		Female	6.6 ± 1.8	4.8 ± 1.9**
		Male	5.3 ± 1.5	3.1 ± 1.5**
Explanation of Terms	10		7.8 ± 1.4	6.8 ± 1.9**
		Female	8.2 ± 1.2	7.3 ± 1.5**
		Male	7.3 ± 1.5	6.0 ± 2.1**
Fill in the Gaps	10		6.8 ± 2.0	6.2 ± 2.4
		Female	7.2 ± 2.1	6.8 ± 2.4
		Male	6.2 ± 1.9	5.3 ± 2.1
True or False	10		6.6 ± 1.6	7.4 ± 2.0**
		Female	6.9 ± 1.7	8.1 ± 1.9**
		Male	6.2 ± 1.4	6.5 ± 1.7
Short Answer Questions	18		14.7 ± 2.8	14.3 ± 2.8
		Female	15.3 ± 2.5	14.9 ± 2.8
		Male	13.8 ± 2.9	13.4 ± 2.6
Long Essay Questions	12		7.9 ± 2.3	6.4 ± 2.4**
		Female	8.5 ± 1.8	7.2 ± 2.1**
		Male	7.0 ± 2.7	5.3 ± 2.5**
Total	100		74.0 ± 11.0	68.7 ± 13.6**
		Female	77.8 ± 10.3	74.1 ± 12.2
		Male	68.3 ± 9.7	60.8 ± 11.7**

**p<0.01, compared with the corresponding estimated performance.

or False, and Long Essay Questions) were statistically significant ($p<0.01$). On average, pharmacy students over-estimated their performance of Multiple Choice, Explanation of Terms, and Long Essay Questions, by 1.9 points (19.0%), 1.0 points (10.0%), and 1.5 points (12.5%) respectively. Only the performance of True or False was under-estimated by 0.8 points (8.0 %). And the above trends are basically consistent in either male or female students.

The plot for the Bland Altman analysis is shown in Figure 1. There was poor absolute agreement and weak relationship between the actual and estimated total scores ($r^2=0.682$, $p<0.001$), the performance of Single Choice($r^2=0.641$, $p<0.001$), Multiple Choice ($r^2=0.248$, $p<0.001$), Explanation of Terms ($r^2=0.478$, $p<0.001$), Fill in the Gaps ($r^2=0.636$, $p<0.001$), True or False ($r^2=0.190$, $p<0.001$), Short Answer Questions ($r^2=0.219$, $p<0.001$), and Long Essay Questions ($r^2=0.359$, $p<0.001$) (Figure 1). The Bland Altman analysis showed a bias of -5.2, -0.6, -1.9, -1.0, -0.6, 0.8, -0.4, or -1.5 points existed in the estimation of the total scores, and 7 types of test item, successively. And the limits of agreement for estimated performance relative to actual performance ranged from -20.3 to 9.8 for the total scores, -6.0 to 4.8 for the performance of Single Choice, -5.6 to 1.7 for that of Multiple Choice, -3.7 to 1.6 for that of Explanation of Terms,-3.4 to 2.2 for that of Fill in the Gaps, -3.0 to 4.6 for that of True or False, -6.0 to 5.2 for that of Short Answer Questions, and -5.7 to 2.7 for the performance of Long Essay Questions. The biases, along with the large limits of agreement of estimated performance suggested the statistical agreement between actual and estimated performance was poor. Besides, 54/57 (94.7%) of the pair wise differences of estimated and actual total scores fall between the upper and lower limits of agreement. And 43/57 (75.4%), 12/57 (21.1%), 29/57 (50.9%), 25/57 (43.9%), 27/57 (47.4%), 34/57 (59.6%) and 28/57 (49.1%) of the data points were within the 95% limits of agreement between the estimated and actual performance of Single Choice,

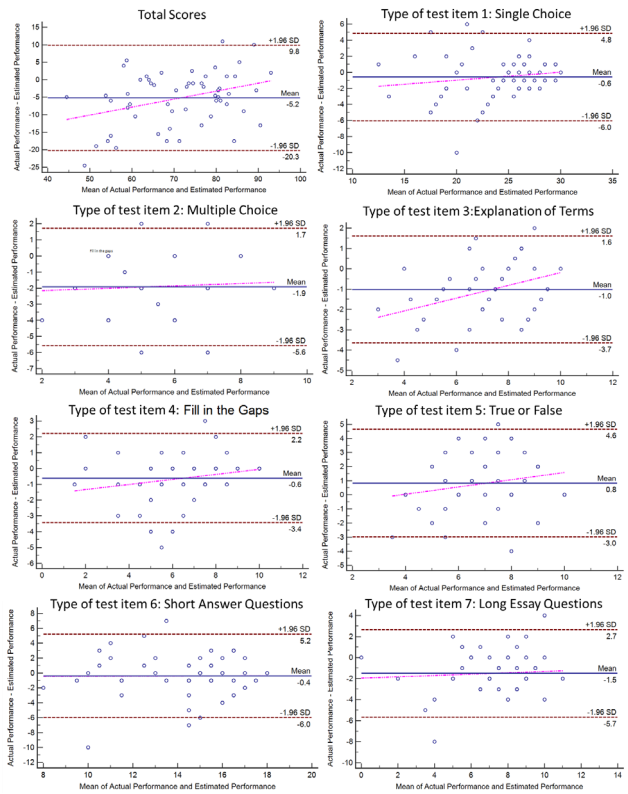

Figure 1: Bland Altman plots depicting agreement between estimated and actual performance (n=57)

Multiple Choice, Explanation of Terms, Fill in the Gaps, True or False, Short Answer and Long Essay questions, respectively.

These results demonstrated that, in general, these respondent Chinese pharmacy students estimated inaccurately, and overestimate their performance after exam, despite the fact that the scores of True or False were underestimated.

Relationship between metacognitive awareness levels and the resultant performance

In addition, this research further explored the potential relationship between metacognitive awareness levels (including the accuracy of self-esitimate/prediction and MCQ-30 scores) the resultant performance. As shown in Figure 2A, 68.4% of students with high accuracy in predicting their performance, 61.5% of under-predicted students, and only 8.3% of the over-predicted ultimately scored above the average. Interestingly, more than half (53.3%) of students who scored above the average under-predicted their performance before exam. And after exam, a negative correlation (r=0.5855) was found between estimated-minus-actual performance difference and the actual performance (Figure 2C). These data showed clear connections between knowledge monitoring accuracy and academic achievement. And it seemed that

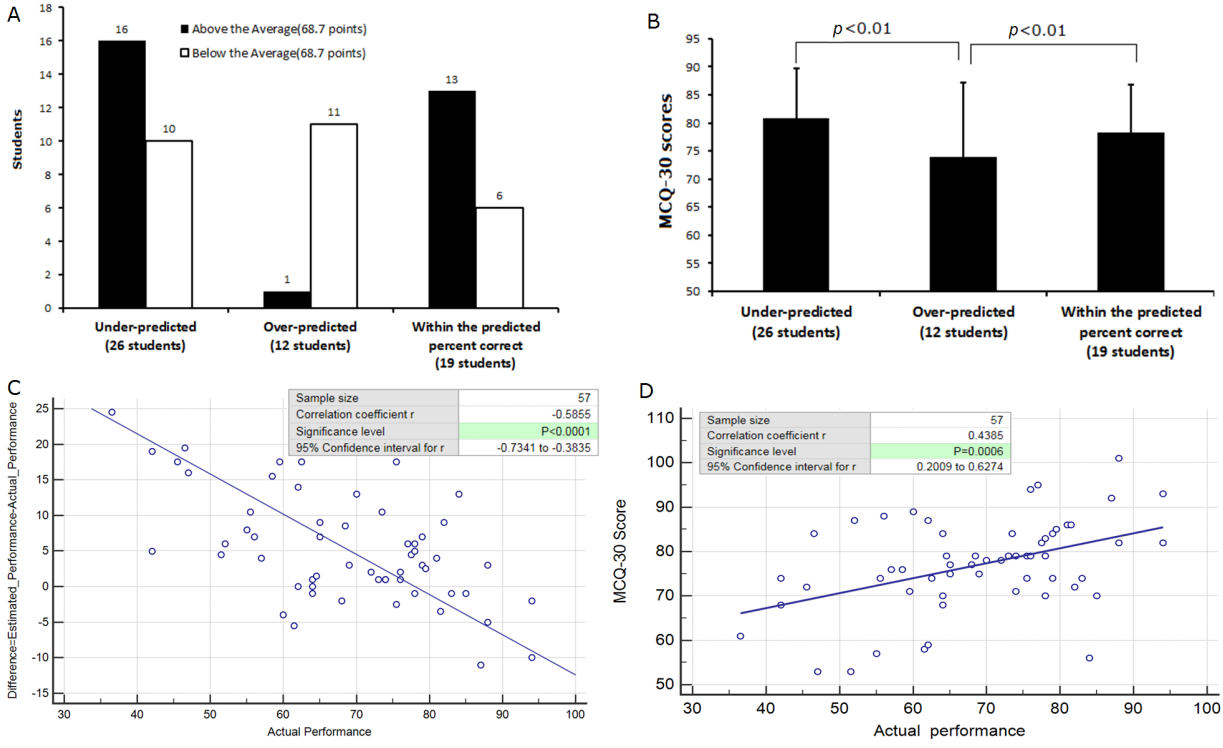

Figure 2: Relationship between meta cognitive awareness levels and the resultant performance (n=57). A: Relationship between self-prediction before exam and the resultant performance. B: MCQ-30 scores of students who accurately, under-or over-predicted their performance. C: Scatter plot of the accuracy of self-esitimate after exam. D: Scatter plot of MCQ-30 scores vs the actual performance

the high-achieving students tend to under-predicted/estimated their performance. Similarly, students who accurately or under-predicted their performance before exam had higher MCQ-30 scores than over-predicted students ($p<0.01$, Figure 2B). Although not in adramatic fashion, a correlation was found between MCQ-30 scores and actual performance, showing that students with higher MCQ-30 scores tend to have higher levels of achievements in the academic exam.

DISCUSSION

As an economical and brief multidimensional measure of a range of metacognitive beliefs and metacognitive processes such as judgments and monitoring tendencies,[15] the MCQ-30 has been widely used in exploring and conceptualizing psychopathological processes, such as emotional distress,[18] eating disorders,[19] chronic fatigue syndrome,[20] etc. In the present study, the MCQ-30 was firstly applied to measure the metacognitive beliefs of Chinese pharmacy undergraduates. Although the research using MCQ-30 to explore the meta-cognition of ordinary under graduates is rare, the mean score of MCQ-30 for third-year Chinese undergraduate pharmacy students in Wuhan University of Science and Technology (76.95) shown in this research was significantly higher than that was reported for control American undergraduate students majoring in clinics and psychology (55.59 ± 17.96).[21] The possible reasons might due to the potential cross-cultural differences in social context, religious beliefs, pedagogical methods and so on, which can influence the metacognitive levels.[22,23] But the exact cause appears to require further researches.

Although good metacognitive briefs manifested as higher MCQ-30 scores were found in third-year Chinese undergraduate pharmacy students in Wuhan University of Science and Technology, further study of student self-testing as a predictor of pharmacology examination scores showed a little poor accuracy of self-prediction/estimate, which was manifested by the results that only 33.3% of students correctly predicted their total scores before exam, and the differences between actual and estimated performance after exam were statistically significant. Meta-cognition played an important role in students' judging the correctness of their answers.[4] According to the hierarchical model of meta-cognition presented by Tobias and Everson,[24] knowledge awareness and monitoring are the foundation of meta-cognition, because effective self-management begins with an individual is assessment of his or her capability. Only one with accurate knowledge awareness and monitoring can successfully employ more complex metacognitive process such as planning, evaluation, and selecting learning strategies. There is a limited body of research that has examined students' perception of knowledge compared with their actual knowledge in an undergraduate course.[25] In this study, students were asked to predict their future examination performance based on their levels of knowledge acquisition prior to actually performing the summative examination on pharmacology (prospective judgments), and estimated the potential performance based on students' self-judgement on the correctness of each question item while checking the test papers in the current testing situation (immediate retrospective judgments). These metacognitive judgments on performance require participants to introspect about the quality of internal cognitive processes, make judgments about their knowledge, and could simply assess the knowledge monitoring. Indeed, performance predictions have been found can improve prospective performance and thus may be a valuable study strategy.[26]

As for the prediction accuracy on the mastery of different chapters before the exam, students appear hard to accurately predict their performance of some difficult chapters, such as *Drugs acting on cardiovascular system*. For relatively simple chapters, such as *Drugs acting on peripheral nervous* and *Chemotherapy drugs*, students made more accurate predictions on their outcomes of learning. An interesting finding of this study is that, in general, Chinese pharmacy students tend to under-predicted their performance before the exam (45.6% participants), however, over-estimated their performance after exam. Students' under-evaluation of the knowledge monitoring before the exam perhaps reflected the lack of confidence on their academic levels. After exam, the actual total scores of pharmacology exam had poor agreement with the estimated, and were over-estimated by 5.3%. Moreover, respondent Chinese pharmacy students' over estimation on the performance after exam, which found in this study, means they are unable to recognize their faults in the exam, and might suggest weak knowledge monitoring. Among all 7 types of test item being taken, Multiple Choice and Long Essay Questions were most over-estimated by 19.0% and 12.5% respectively. Compared with Single Choice, Multiple Choice has a greater ability to test knowledge, factual recall test and the "problem solving" skills. And examinees who score higher on Multiple Choice can more accurately monitor their knowledge. Long Essay Questions measure the knowledge not only at the recall level, but also at application and analysis levels in performance. These two types of test item are powerful in assessing cognitive skills such as organization of knowledge, reasoning and problem solving, thus could involve students in higher-

order learning activities.[27,28] Therefore, the inaccuracy of students' self-estimate on Multiple Choice and Long Essay Questions is possible due to their weak higher-order learning skills. Another explanation on over-estimation may be, after completing the test paper, students found that the exam is actually not as difficult as they thought, and they under-predicted their performance before exam. Therefore, they might feel that it seem not necessary to lack self-confidence, then, might re-adjust their psychological orientation from lack of self-confidence to self-conceit, which lead to biases in the measurement of metacognitive awareness. However, the exact reason for inconformity between MCQ-30 scores and the results in self-estimate on performance after exam needs further and more detailed researches.

Importantly, a trend was identified showing that higher performing students had greater metacognitive awareness. Sixty eight percent of students with high accuracy in predicting their performance before exam scored above the average in the resultant exam. Student who had higher actual scores, also make more accurate estimate after exam. Students had higher MCQ-30 scores tend to more accuratly predict their performance, and achieve higher marks in the actual exam. These results suggested that participants' metacognitive awareness seemed to reflect their actual performance. This supports the idea put forward by de Carvalho Filho[29] that high-metacognitive students presented more effective test preparation practices, better test performances, superior attributional, regulatory, and monitoring processes than their counterparts. Interesting, a major of students (61.5%) who under-predicted their performance actually score above the average, implying that students achieving high actual scores tend to conservatively estimated their performance when checking test papers. These results of this study suggested that high-achieving students might demonstrate a growth mind setrealizing there is more to learn, thus perhaps underestimate their performance.

Originally, it is believed that there is no significant difference in meta-cognition levels between different genders.[15] But in some sub sequentre searches, male-female difference in MCQ-30 scores was reported. For example, Typaldou *et al*.[30] found that Greek women scored significantly higher than men in the overall MCQ-30 and the "Negative beliefs about worry" and "Need for control over thoughts" subscales. Similarly, the effect of gender was significant on some of the subscales of MCQ-30 in Turkish university students.[31] This gender effect was speculated to result from cultural differences.[30] Besides, when examining student performance on a science reasoning quiz, women had been found to significantly underestimate their scientific ability compared with men, suggesting a gender-related difference between perception of skills or knowledge.[32] This study found a gender difference in "Need for control over thoughts" subscale. However, this study did not show evidence of male-female difference in the total MCQ-30 scores and other subscales, together with the results about accuracy of pharmacy students' performance prediction/estimate before/after exam. The possible explanation is that the fast internationalization or westernization over the past decades in China lead to the change in gender role expectations. However, further investigations which compare the levels of metacognitive awareness in a larger Chinese sample are needed to clarify the exact influence of gender.

Nevertheless, there are several limitations in this study. Firstly, the use students' prediction of the score they are likely to obtain in an examination as an indicator of their metacognitive skills is a little simplistic, subjective and not straight-forward. The chances of over-or under-prediction are always high and this is simply due to the complex interactions of so many associated variables such as aptitude for the course, students' perception of the course, the course instructor and the instructional strategies used, the course materials and its alignment with the course objectives/intended learning outcomes, the assessment tasks used, and its consistency with the course objectives, etc. There are many factors that can confound such predictions before or after the examinations. Thus, a further research for a more overall evaluation of metacognitive awareness is needed based on this preliminary study. Besides, only 57 third-year pharmacy undergraduates at the single Chinese university were included in this study. For better representing all Chinese pharmacy students, a replication of the study with a larger sample of Chinese pharmacy students from multiple institutions and different grades could strengthen our findings.

CONCLUSION

Assessing and improving metacognitive awareness in pharmacy students is essential to maintaining the lifelong competency of pharmacists and high-quality care for their patients. This preliminary study indicated that the mean MCQ-30 score of 57 third-year Chinese pharmacy undergraduates in Wuhan University of Science and Technology was 76.95. However, only 33.3% of students correctly predicted their total scores before exam, and the differences between actual and estimated performance after exam were statistically significant. Moreover, students who accu-

rately or under-predicted their performance before exam had higher MCQ-30 scores than over-predicted students. Thus, it is necessary to explore effective educational methods to help Chinese pharmacy students practically develop metacognitive awareness and skills by creating an awareness of their existing knowledge.

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CONFLICTS OF INTEREST

There is no conflict of interest for the present communication.

ABBREVIATION USED

MCQ-30 : The 30-item meta-cognitions questionnaire; **ID :** Identification; **SD :** Standard deviation.

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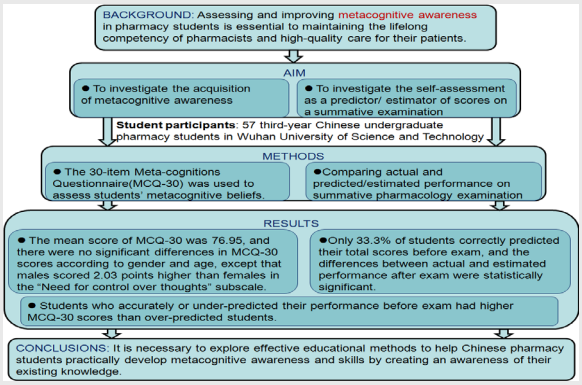
PICTORIAL ABSTRACT



SUMMARY

- This preliminary study applied the 30-item Meta-cognitions Questionnaire (MCQ-30) to assess students' metacognitive beliefs, and indicated that the mean MCQ-30 score of 57 third-year Chinese pharmacy undergraduates in Wuhan University of Science and Technology was 76.95.
- The results from the self-assessment as a predictor/estimator of scores on a summative examination showed that only 33.3% of students correctly predicted their total scores before exam, and the differences between actual and estimated performance after exam were statistically significant.
- Students who accurately or under-predicted their performance before exam had higher MCQ-30 scores than over-predicted students.

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