Research on the Undergraduates’ Structure of Meta-Learning Ability

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Abstract: As the application of meta-cognition theory in learning filed, the structure of meta-learning ability has not unified definition. This paper tried to define it from the perspective of empirical analysis. Three dimensions and six ability factors constituted the structure of meta-learning ability, basing on which meta-learning ability structure questionnaire was prepared. After sampling survey, through item analysis, exploratory factor analysis, reliability analysis and validity analysis, the structure of meta-learning ability was verified, which can measure undergraduates’ meta-learning ability comprehensively.

Introduction

The ability of learning is a means, or a skill. However, as the number of undergraduates increases year by year, the learning ability of them is generally decreased. People pay more attention to “which university to go”, but ignore “how to study in university”. The undergraduates' learning has become a passive activity. Learning therefore becomes a burden.

The introduction of "meta" into university classroom teaching is a kind of promotion of educational ideas. The definitions of meta-learning from the researchers are not the same, but the essential meaning of meta-learning defined is similar, which is that the learner itself rather than the teacher as the subject and the center of the study is responsible for his own learning and monitoring [1-4]. As the application of meta-cognition theory in learning filed, lots of studies have indicated that the development of students' meta-learning ability has a significant impact on the improvement of academic performance [5-6]. However, there are different opinions about the elements of meta-learning ability [7-10]. Whether the structure of the meta-learning ability can draw lessons from the division of meta-cognition elements which are divided into static part and dynamic part claimed by most researchers. Aiming at undergraduates, this article would analyze it from the aspects of the empirical analysis.

Relevant Theoretical Hypothesis

Meta-learning was first proposed by Maudsley, he believed that the learners could gradually control their ideas, learning and growth through meta-learning consciousness [1]. From the view of learners’ ability, Biggs thought that meta-learning ability should contain the following contents: the ability to establish the goal of learning; the ability to realize the different learning methods which would produce different learning results; the ability to monitor psychological activity; the ability to evaluate through information feedback; the ability to anticipate the process and the result [2]. Dong used the factor analysis method to divide meta-learning activities into 3 aspects: self-monitoring before learning activities, self-monitoring in the process of learning activities, self-monitoring after learning activities. These 3 aspects also contain 8 dimensions, such as feedback, summary and so on [5].

As an extension of the theory of humanism education theory, meta-learning inherits the characteristics of it, such as emphasis on human factors, promoting students' ability of learning to learn, reinforcing learning motivation and learning effect, and so on [11]. Thus, we claim that: 1) the most important factor is the subject of learning in meta-learning process; 2) the ability of establishing motivation and incenting
should be included in the meta-learning ability; 3) evaluating meta-learning ability should measure the ability of learning to learn, rather than learning ability. In summary, the meta-learning ability should contain at least the following abilities: 1) cognition ability, which is the ability to acquire knowledge and the ability of changing experience and practice into knowledge; 2) motivation establishment ability, which is the ability to establish feasible goal motivation; 3) strategy selection ability, which is the ability to choose a good method of learning; 4) regulation ability, which includes the ability of adjustment and feedback; 5) incentive ability, which can convert motivation to power, convert theory to practice, convert passive learning to active learning; 6) perception ability, which includes perceiving the current environment and their own situation, perceiving their own emotion change and mentality fluctuation caused by learning effect.

**Conception of Undergraduates’ Meta-learning Ability Structure**

Meta-learning is the learning process of students' self-awareness and regulating; it needs take meta-learning knowledge as the basis, achieve the control of meta-learning through experiencing meta-learning process. Among them, meta-learning knowledge is a static factor, meta-learning control and meta-learning experience are the dynamic factors. Based on that, meta-learning ability of undergraduates is assumed that the ability structure of meta-learning could be divided into three dimensions, which are meta-learning knowledge, meta-learning control and meta-learning experience. Each dimension has its own function, but also complements each other.

1) **Meta-learning knowledge.** This dimension mainly includes cognition ability and motivation establishment ability. It emphasizes on students' own cognition of learning tasks, learning methods, and learning meaning; it also underlines students' establishment of learning motivation, learning goals and self-efficacy.

2) **Meta-learning control.** This dimension mainly includes strategy selection ability and regulation ability. In the process of learning activities, students need to choose the correct method, make the appropriate learning plan, and regulate, evaluate and feedback their own learning process.

3) **Meta-learning experience.** This dimension mainly includes incentive ability and perception ability. Experience refers to the individual awareness and understanding of the situation of learning activities, which includes confidence caused by the incentive in the process of learning, and also includes the achievement experience, emotional experience and peak experience generated because of applying theory to practice in the learning process.

The above concept of three-dimensional structure has determined the specific boundaries, but still has some shortcomings. This is because the three dimensions not only have overlapping parts, but also mutually transform in the process of learning. For example, meta-learning knowledge provides knowledge background for meta-learning experience; in meta-learning control process, the feedback of experience turns into students' new meta-learning knowledge. The interaction of the three dimensions constitutes the system structure of students' meta-learning ability, which is showed as Fig. 1.

![Figure 1. Structure system of meta-learning ability.](image-url)
An Empirical Analysis of Undergraduates’ Meta-learning Ability Structure

The First Test for Undergraduates’ Meta-learning Ability Structure

According to the above analysis, this paper follows the procedures to establish original "Undergraduates’ meta-learning ability questionnaire".

(1) Literature review. Based on Humanism and quality-oriented education theory, the theories of meta-cognition and meta-learning are analyzed, the meta-learning related items are collected.

(2) Interview survey. First, the topic of “Undergraduates meta-learning ability” is launched in a university, then 8 undergraduates are interviewed face to face. The interview content relates to undergraduates’ learning cognition, control and experience in learning process, and especially highlights the six ability factors.

(3) Items confirmation and classification. The corresponding questionnaire is developed through items confirmation and classification and then the original questionnaire is obtained.

(4) Questionnaire modified. The readability for some items is modified and then 108 items are formed. 120 questionnaires are distributed in a university, the mode of random sampling is adopted and significant T test is used, then 41 items are deleted.

The Second Test for Undergraduates’ Meta-learning Ability Structure

According to "Undergraduates' meta-learning ability questionnaire" test, the result is analyzed and items are sifted furthermore. 2 teachers are invited to evaluate it, the readability and rationality are taken into consideration according to the evaluation results, and the finally version is formed which includes 60 items. 320 questionnaires are distributed in the university and the reliability and validity of questionnaires are analyzed.

(1) Exploratory factor analysis. Exploratory factor analysis is carried out, KMO value is calculated 0.907, p<0.001 through Barlett test, which shows that the questionnaire is suitable for factor analysis. Through principle component analysis, the characteristic root is extracted which is bigger than 1 after varimax rotation. 3 new factors are generated, total explanation percentage of variance is 52.703%, which is showed as Table 1.

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial characteristic value</th>
<th>Sum of squares</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>Percentage of variance %</td>
<td>Percentage of variance %</td>
</tr>
<tr>
<td></td>
<td>Accumulation</td>
<td>Accumulation</td>
</tr>
<tr>
<td>1</td>
<td>8.062</td>
<td>4.011</td>
</tr>
<tr>
<td></td>
<td>38.161</td>
<td>18.094</td>
</tr>
<tr>
<td></td>
<td>38.161</td>
<td>18.094</td>
</tr>
<tr>
<td>2</td>
<td>1.888</td>
<td>3.988</td>
</tr>
<tr>
<td></td>
<td>7.775</td>
<td>17.711</td>
</tr>
<tr>
<td></td>
<td>45.936</td>
<td>35.805</td>
</tr>
<tr>
<td>3</td>
<td>1.1321</td>
<td>3.0831</td>
</tr>
<tr>
<td></td>
<td>6.767</td>
<td>16.898</td>
</tr>
<tr>
<td></td>
<td>52.703</td>
<td>52.703</td>
</tr>
</tbody>
</table>

(2) Reliability analysis. The reliability analysis result of questionnaire is showed as Table 2. The homogeneity reliability and the split-half reliability of questionnaire are 0.898, 0.865, respectively. The homogeneity reliability and split-half reliability of each dimension also achieve a high level. Thus, the questionnaire has high internal consistency.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Meta-learning knowledge</th>
<th>Meta-learning control</th>
<th>Meta-learning experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homogeneity reliability</td>
<td>0.898</td>
<td>0.879</td>
<td>0.820</td>
</tr>
<tr>
<td>Split-half reliability</td>
<td>0.865</td>
<td>0.819</td>
<td>0.778</td>
</tr>
</tbody>
</table>
Validity analysis. As shown in Table 3, the correlation coefficient between dimension and questionnaire is significantly greater than correlation coefficient between the factors, which proves that the validity of the questionnaire is good.

Table 3. Correlation coefficient.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Meta-learning knowledge</th>
<th>Meta-learning control</th>
<th>Meta-learning experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meta-learning knowledge</td>
<td>0.728</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Meta-learning control</td>
<td>0.855</td>
<td>0.334</td>
<td>1</td>
</tr>
</tbody>
</table>
| Meta-learning experience | 0.654       | -0.180                | -0.245                  | 1

The correlation coefficient between meta-learning control and questionnaire is the biggest, which shows that meta-learning control is the most important part in meta-learning ability structure. Correlation coefficient among three dimensions is lower, which shows that incomplete independence exists among structure factors, and there are overlapping and converting possibilities among factors. That is consistent with the concept of ability structure proposed.

Summary

Undergraduates’ meta-learning ability structure divided into three dimensions can show and develop meta-learning ability best. Meta-learning knowledge could be the basis; the information is exchanged between external environment and students through meta-learning experience; then, each dimension can be integrated to new meta-learning knowledge and meta-learning experience through meta-learning control, move in circles, so as to promote the development of students’ meta-learning ability. Through sampling investigations and statistical analysis, the questionnaire is obtained which has good reliability and validity, the rationality of the structure of meta-learning ability is verified. In the process of establishing the formal questionnaire, part of items which belong to meta-learning knowledge dimension affect the score of meta-learning control dimension, which proves that the transformation relationship among factors exists in the concept model of structure. The structure can truly reflect the meta-learning ability of undergraduates.

In the survey processes, we also have found out that some undergraduates still do not form their own meta-learning ability system. Educators should focus on establishing and developing the knowledge system of meta-learning ability of undergraduates, and achieve some aspects that mentioned in the following: 1) guiding students to self-cognition, providing learning strategies to students which can be drew lessons from in their learning process, promoting students' positive and active learning, and systematizing students’ meta-learning knowledge furthermore; 2) advocating planned learning, helping students learn time management, strengthening students' meta-learning strategy selection and monitoring ability; 3) providing the relevant information including learning efficiency and learning task changes, making students understand their own motivation ability and perception ability in meta-learning processes through the questionnaires before and after learning activities, using multi-angle evaluation system to enhance students' meta-learning experience.

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References


