Research on Mathematics Learning Force Model of College Students Based on Moso-teaching and Math-Applet Model

Guo-xing DAI*, Ting-wei LI, Yi-ren FENG and Yun-fei JI
Jiangsu University, Zhenjiang City, Jiangsu Province, China
*Corresponding author

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Abstract. Based on the Moso-teaching model and Mathematical applet, this paper collected data of university mathematics teaching, and analyzed the learning situation of students by constructing the learning force model. Analyze the factors related to students’ learning ability through data model; and through the analysis of each factor, deepen the teachers’ understanding of the students’ learning style of mathematics, and provide reference for the improvement of teaching method and evaluation method.

Research Status and Development Trend at Home and Abroad

Relevant literatures were searched by the keywords of learning power, academic motivation, learning perseverance, learning ability, learning power, learning ability, and learning capacity. Through preliminary reading, it is found that the systematic research on the theory of learning force mainly focuses on foreign literature, especially the literature research in Britain is relatively in-depth, while the domestic literature research is relatively few, and no systematic research has been formed. In his academic paper published in 1965, professor Forrest of the Massachusetts institute of technology put forward the concept of "learning force" for the first time and discussed the organizational learning force, believing that organizational learning force is the comprehensive embodiment of the motivation, perseverance and ability of learning.

The study of learning force started relatively late in China, and there are few relevant literatures. In his book learning ability = competitiveness, scholar Hua-bin Wang elaborated the connotation and components of learning ability and proposed a new learning method and strategy -whole brain super potential learning. With the continuous development of higher education, more and more colleges and universities attach great importance to the research on the types of students’ learning. It is believed that the types of students’ learning will be paid attention to and studied by more and more teachers, which will be of great help to the development of higher education.¹²

The Necessity and Development Prospect of Moso-teaching Model Research

The teaching mode can be defined as a relatively stable framework and program of teaching activities under the guidance of certain teaching ideas or theories. As a structural framework, the teaching mode highlights the internal relations and functions of the whole teaching activity and the elements from a macro perspective. As an activity program, it highlights the orderliness and operability of the teaching mode.

Students need to strengthen their extra-curricular studies. In the past, extracurricular activities were considered complementary to classroom instruction, but data from American universities show that 80 percent of all important specific events that have a profound impact on students take place outside the classroom.

Moso-teaching Model can provide diversified forms, such as the barrage, check-in, brainstorming, questionnaire survey, vote, random roll call to ask questions, group discussion, real-time display and peer mutual learning results and so on, these expanded the teaching activities in the form of content, to better support individuals and groups to participate in the answering question discussion,
problem solving and creative activities. At the same time, it builds a bridge for active participatory learning, effectively breaks through the single teaching-style classroom teaching method, achieves the effect of stimulating students' multi-sensory participation and deep thinking, and greatly improves the classroom teaching efficiency and students' learning efficiency.\cite{3}

**Students Learn the Connotation of Strength**

Learning ability is composed of three elements: learning motivation, learning perseverance and learning ability. The mathematics learning ability of college students studied in this project refers to the comprehensive embodiment of a college student's motivation, perseverance and ability to learn mathematics. Students' individual learning ability includes not only the individual knowledge, namely the breadth and width of the individual learning content and organization and the openness of the individual, but also the individual quality of learning, such as comprehensive quality, learning efficiency and quality, as well as the flow of learning it, i.e. the speed of learning and ability to absorb and expanded knowledge; What is more important is the increment of individual knowledge, that is, the innovation degree of learning results and the degree to which learners transform knowledge into value.

"Learning power" originated from the management research of "learning organization". The concept was first proposed in 1965 by Jay Forrester of Massachusetts institute of technology. In the mid-1990s, learning became widely used in management and culture. According to Hirooka, learning force has three structures: inner layer, middle layer and outer layer. Wu Zhenli believes that learning ability is the most valuable vitality, the most basic creativity and the most core competitiveness. It is the organic combination of learning ability to launch, maintain, promote, improve and innovate systematically and deeply. In this study, learning ability is divided into three aspects: learning motivation, learning perseverance and learning ability.\cite{4}

**Factors Affecting Students' Learning Ability**

Online learning based on cloud platform is a new way of learning. One of the manifestations of students' online learning ability is their participation in learning on cloud platform. The main influencing factors are personal factors, peer factors, teacher factors and resource factors.

According to the experimental data, it is found that in the process of online learning, resource factors have the greatest influence on students' participation, followed by peer factors and teacher factors, and finally individual factors. In the process of online learning, students pay more attention to the excellent degree of teaching resources, have a great interest in the concise and high-quality teaching resources, and can participate in online learning more actively. Meanwhile, the arrangement of group cooperation and mutual evaluation in online learning can stimulate students' learning enthusiasm and help them improve their learning efficiency. Teachers have a considerable authority in the learning process, the appropriate release of tasks, clear students' learning direction, help students to clearly and orderly continue to learn, form a long-term learning process. Although individual factors are statistically the least influential, they still have a significant impact. When students can clearly understand their learning needs, their learning motivation and perseverance will be improved, and they will be able to participate in the learning process with self-control and perseverance. They will not be tired of learning or lack of confidence, which will lead to the lack of enthusiasm for learning.

**Research Methods**

The research data of this project are from the cloud class, and the data are collected from two classes in Jiangsu University that are studying advanced mathematics. There were 106 students in two classes of advanced mathematics, and the students participated in the study survey through the "Moso-teaching" software.\cite{5}

With the structure of "input-process-output", the learning category model of students is
constructed from four aspects: class activities, autonomous learning (Embed the Geogebra math-applet in the Moodel to calculate activity completion), homework and classroom efficiency.

The H5P activity module enables our course to create interactive content such as Interactive Videos, Question Sets, Drag and Drop-Questions, Multi-Choice Questions, Presentations and much more. User interactions and scores are tracked using xAPI and are available through the Moodle Gradebook. We also obtained learning data from SCORM activities. SCORM activities may be used for presenting multimedia content and animations, as an assessment tool.

Among them, the cloud class activities include discussion and answering questions, brainstorming, and voting questionnaires. Independent learning includes video resource learning and non-video resource learning. Class assignments include tests, assignments, and group assignments (Math-applet cooperative learning and active use of Math topics); Classroom efficiency includes attendance and classroom performance. In this project from the perspective of college students, the model is constructed and analyzed based on the framework of "input-process-output" to analyze the types of students' learning, the proportion of relevant learning types and the influence of various factors on the final performance, so as to provide references and Suggestions for the improvement of teaching evaluation in the future.

**Students' Learning Type Analysis[6]**

**Cluster the Factors that Affect the Performance and Verify the Weight**

In order to ensure that the factors constituting the learning category have a reasonable weight distribution, based on the weight distribution of the existing teaching evaluation, we recalculate the weight of various factors affecting the performance in 1-10 grades.

![Figure 1. Original weight distribution.](image)

<table>
<thead>
<tr>
<th>Learning video resource</th>
<th>Non-video resource</th>
<th>attendance</th>
<th>test</th>
<th>Discuss the answer</th>
<th>brainstorming</th>
<th>Vote questionnaire</th>
<th>Homework/group work</th>
<th>Classroom performance</th>
<th>Teacher thumb up bonus points</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>8%</td>
<td>2%</td>
<td>25%</td>
<td>5%</td>
<td>10%</td>
<td>5%</td>
<td>25%</td>
<td>5%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Then, ten categories were clustered, and the factors affecting performance were summarized into four learning categories, and the weight distribution of four learning categories in the original data was obtained:

- $P_1$: classroom efficiency (attendance, classroom performance) $P_1=7$, weight 0.07
- $P_2$: class work (tests, assignments) $P_2=50$, weight 0.5
- $P_3$: independent learning (video learning, non-video learning) $P_3=18$, weight 0.18
- $P_4$: cloud class activities (discussion and answering, brainstorming, voting questionnaire) $P_4=25$, weight 0.25

$$w^{(1)}P_1 P_2 P_3 P_4 = (0.07, 0.5, 0.18, 0.25)$$

**Establish Pairwise Comparison Matrix A.** Here, the classification of the three categories of influencing factors after clustering is just for the convenience of strength comparison. Now, the pairwise comparison matrix of ahp model is used to recalculate the weight of the three categories and verify it, and the pairwise comparison matrix A is obtained

$$A = \begin{pmatrix}
1 & 2 & \ldots & k - 1 & k \\
\frac{a_{11}}{a_{21}} & \frac{a_{12}}{a_{22}} & \ldots & \frac{a_{1(k-1)}}{a_{2(k-1)}} & \frac{a_{1k}}{a_{2k}} \\
\vdots & \ddots & \ddots & \vdots & \vdots \\
\frac{a_{(k-1)1}}{a_{k1}} & \frac{a_{(k-1)2}}{a_{k2}} & \ldots & \frac{a_{(k-1)(k-1)}}{a_{kk}} & \frac{a_{(k-1)k}}{a_{kk}}
\end{pmatrix}
$$

$$A = \begin{bmatrix}
1 & 7/50 & 7/18 & 7/25 & 50/7 & 7/1 & 25/9 & 2/18 & 7/9 & 25/1 & 18/25 & 25/7 & 1/2 & 25/18 & 1
\end{bmatrix}$$
The maximum eigenvalue of the matrix is calculated as $\lambda = 0.8017$

**Consistency Test:**

In the consistency test:

The paired comparison matrix is not usually a uniform matrix, but in order to use its eigenvector corresponding to the eigenroot lambda as the weight vector of the compared factor, as long as the degree of inconsistency is within a certain error range.

$$\text{CI} = \frac{\lambda - n}{\lambda - 1}$$

is defined as the consistency index, and the values of random consistency index RI are shown in the following table (1)

![Figure 2. Table values of random consistency index.](image)

When the consistency ratio $\text{CR} = 0.8017 < 0.90$ is calculated, the degree of inconsistency is considered to be within the allowable range. (2)

After calculation, $\text{CR} = \frac{\lambda - n}{\lambda - 1}$ within the allowable range, the weight vector is obtained by normalizing its feature vector, denoted as: 0.8017

$w^{(1)} = (0.07, 0.5, 0.18, 0.25)$ is the weight assigned to the original score.

It is found that the weight vector after ahp has a big gap with the original weight vector, which is caused by the large interval of intensity allocation. Therefore, in this case, we try to adjust the intensity ratio to obtain a more accurate weight allocation ratio.

Optimize the intensity ratio, and make $A = \begin{bmatrix} 1 & 1/2 & 2 & 1 \\ 2 & 1 & 3 & 2 \\ 1/2 & 1/3 & 1 & 1/2 \\ 1 & 1/2 & 2 & 1 \end{bmatrix}$

After calculation, $\text{CR} = \frac{\lambda - n}{\lambda - 1}$ is within the allowable range and the error is smaller than that before optimization. After the normalization of its eigenvectors, the weight vector is obtained, which is denoted as: $\text{Cl} = \frac{0.0104}{0.90} = 0.0115 < 0.1\lambda$

$w^{(1)} = (0.07, 0.5, 0.18, 0.25)$ is the weight assigned to the original score.

**Results of weight test:** $w^{(2)} = (P1, P2, P3, P4) = (0.1, 0.45, 0.2, 0.25)$, is the final result.

**Analysis of weight test results:** By hierarchical analysis model, to the teacher the original experience as the foundation, will affect factors of the performance of clustering and classify the level of strength, can be more sure the assignments in the students learning type occupies a larger proportion, the proportion of species of autonomous learning in students' learning rather than the thought of teachers less often. This also reflects that the learning types of students' independent learning do not meet teachers' expectations and the current situation is not satisfactory.

Next, we will conduct a more in-depth analysis of the three learning types of students, and discuss the accurate composition of the learning types of students and verify them.

**Take Data 1 as an Example to Analyze the Influence of Three Types of Learning Factors on Students' Performance** Data 1: advanced mathematics (106 people)

Calculate the variance of the original score and study the importance of variance analysis factors after reducing one factor (SPSS)

In order to explore the learning types that have the greatest impact on students' performance, we use the variance of the variance of the total score as the measurement standard. After removing a certain student's learning category, the variance of the total score of the remaining three categories relative to the original variance was studied, which had the greatest impact on the variance of the total score M, that is, it was deemed to have the greatest impact on the student's performance.
Total score $M$: class efficiency + class work + independent learning + cloud class activities
Total score $M_1$: class work + independent learning + cloud class activities
Total score $M_2$: classroom efficiency + independent learning + cloud class activities
Total score $M_3$: class efficiency + class work + cloud class activities
Total score $M_4$: class efficiency + class work + independent learning

Figure 3. Variance calculation results.

<table>
<thead>
<tr>
<th>Results type</th>
<th>$M$</th>
<th>$M_1$</th>
<th>$M_2$</th>
<th>$M_3$</th>
<th>$M_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>The results of variance</td>
<td>5269.596</td>
<td>4150.967</td>
<td>1227.675</td>
<td>4579.018</td>
<td>4395.162</td>
</tr>
</tbody>
</table>

Calculate the influence of each factor on the total score $G$, $G_i = \frac{M-M_i}{M} \times 100\%$ the result is

<table>
<thead>
<tr>
<th>Factor types</th>
<th>$P_1$</th>
<th>$P_2$</th>
<th>$P_3$</th>
<th>$P_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affect the size</td>
<td>21.227%</td>
<td>76.702%</td>
<td>12.104%</td>
<td>16.593%</td>
</tr>
</tbody>
</table>

According to the analysis and calculation results, the total score fluctuates in different sizes after a certain factor is missing, and these different fluctuations are the reflection of the influence of each factor on the total score. From the data of influence size, it can be seen that the factor that has the greatest influence on the total score is the class work.

**Use the Mean Deviation Method to Analyze Students’ Study Habits (Excel)**

The mean deviation method is used to analyze the study habits of each student. In other words, the longitudinal average of the performance of each learning type is calculated, and the deviation ratio of each student's performance of each learning type relative to the average is calculated, so as to study the students' learning habits.

From the results of the four categories of students after clustering, the average scores of each category are calculated. Then, the difference between the original results and the average of the students is calculated. The percentage of the difference in the average is calculated.

Students are classified according to the degree of inclination.

- **Comprehensive development type**: each kind of study is far above average level
- **Balanced development**: all the learning types are above the average level but there is no outstanding learning type
- **Diligent hobby type**: classroom work study is far above average level, other study is average
- **Social active type**: cloud class activity study is far above average level, other study is average
- **Passive learning type**: the difference between each kind and average level is small
- **Learning negativity**: all categories are well below average

The average value of each factor deviation of each learning type was calculated, and the proportion of each learning type in the total population was recorded. The results were as follows:

Figure 5. Study type proportion diagram.

<table>
<thead>
<tr>
<th>Student type</th>
<th>The classroom efficiency</th>
<th>The assignments</th>
<th>Autonomous learning</th>
<th>Cloud class activities</th>
<th>The number of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall developmental type</td>
<td>14.87%</td>
<td>14.71%</td>
<td>1.82%</td>
<td>3.20%</td>
<td>37.73%</td>
</tr>
<tr>
<td>Balanced development type</td>
<td>-8.90%</td>
<td>2.14%</td>
<td>0.58%</td>
<td>0.49%</td>
<td>0.94%</td>
</tr>
<tr>
<td>Diligent and loving type</td>
<td>24.02%</td>
<td>15.68%</td>
<td>-64.73%</td>
<td>-0.12%</td>
<td>33.01%</td>
</tr>
<tr>
<td>Socially active</td>
<td>-12.90%</td>
<td>-20.74%</td>
<td>-2.41%</td>
<td>-5.05%</td>
<td>21.70%</td>
</tr>
<tr>
<td>Passive learning type</td>
<td>-7.60%</td>
<td>-45.46%</td>
<td>1.82%</td>
<td>-2.90%</td>
<td>4.72%</td>
</tr>
<tr>
<td>Learning negativity</td>
<td>-30.02%</td>
<td>-75.34%</td>
<td>-1.37%</td>
<td>-2.43%</td>
<td>1.88%</td>
</tr>
</tbody>
</table>

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(1) the proportion of students with comprehensive development is 37.73%, and the average of the four aspects of classroom efficiency, classroom work, independent learning and cloud class activities is the highest in all six categories.

(2) the proportion of students with balanced development is 0.94%, with the average slightly higher than the average in the four aspects of class efficiency, class work, independent learning and cloud class activities.

(3) the proportion of diligent and hobby students was 33.01%, which showed outstanding performance in class work, while other aspects were close to the average level.

(4) the proportion of socially active students is 21.70%, which is outstanding in cloud class activities and close to the average in other aspects.

(5) the proportion of passive learning students is 4.72%, which is at an average level in the three aspects of class efficiency, class work and independent learning, and poor in cloud class activities.

(6) the proportion of students with negative learning is 1.88%, and the average of the four aspects of class efficiency, class work, independent learning and cloud class activities is the lowest in all six categories, and far below the average level.

Discussion and Summary

Based on the data of students' cloud classes in a comprehensive university, this study makes an in-depth study of the after-class data of cloud classes, and makes a comparative analysis of the data of students' cloud classes in a comprehensive university. The analysis results can provide a basis and Suggestions for the development of students' training plans in such universities. According to the above case analysis and the results, we can analyze and discuss the state of college students' mathematics learning ability according to the differences of students' learning types:

Learn the Type Factor

Based on the special teaching design of cloud class, the learning types of students are divided into four aspects: classroom efficiency, classroom work, autonomous learning and cloud class activities. The four aspects complement each other and reflect the data of students' learning. These four aspects are closely related to the core quality of mathematics, which reflects the mathematics learning ability of college students from various aspects.

In this study, we took the semester grades of advanced mathematics as a specific case, and through cluster analysis and comparison of various methods, we found that only in the aspect of autonomous learning, the theoretical weight was lower than the weight expected by teachers.

This verification shows that students' independent learning generally fails to reach the expected level of teachers, and it can be found in the following longitudinal comparison that the main factors affecting students' performance are reflected in the cloud class activities, rather than the students' independent learning. That is to say, the learning part of the cloud class can more intuitively express students' learning, but there is no good way to test students' mastery of the autonomous learning part.

The teaching mode of cloud class is more to bring convenience, but not only to pursue convenience, but also to find ways to improve students' self-study ability, so that students can consciously and actively accept, absorb and internalize the professional knowledge and skills taught by teachers, and strive to improve their learning ability, to lay a good foundation for their own development.

It Comes Down to Learning

According to the above analysis report, the motivation, perseverance and ability of learning force can be summarized as follows: students' lack of learning motivation will lead to their inability to carry on the complex learning; Learning perseverance is an inherent quality, no good quality of perseverance, there is no way to adhere to the complex learning; Learning ability is less affected by innate factors, mainly the formation of acquired habits. Through data analysis, we find that most students have insufficient motivation to study. If they do not form an interest in the subject, they will have no interest in in-depth and systematic study. In the cloud class all the learning is
independent, students need to learn consciously. Ability to learn from students in the process of growth for learning habit, considering the students enter the same university through the college entrance examination, learning ability should not have extreme polarization phenomenon, but the environment and quality of university education environment is different, more important is the students' self-management, to the requirement of students' study perseverance and ability to learn will be higher. How to reform the teaching mode of cloud class and update and optimize online and offline products is a problem that relevant researchers need to consider in the future. This research gives the following directions: 1. Attract more students to learn, enjoy learning and love learning through product optimization. 2. Let colleges and universities comprehensively promote the cloud class model, and open the teacher resource base, so that teachers can use it as a teaching design platform, give full play to the talents of college teachers, and make full use of the advantages of the cloud class model to drive students to learn. 3. By adding the function of cloud class, it will become a comprehensive and fully functional network teaching platform. 4. Add supervision mode to cultivate students' self-control and study habits.

The above analysis is based on the in-school analysis of a university, and it provides some conclusions and Suggestions for students to explore learning types by comparing different university experiences. However, when the study types of students from different universities are compared horizontally, different results may be obtained. The teaching reform of higher education is developing towards a new trend of student-oriented, learning-centered, student-oriented, and study-oriented. The results show that different types of students' learning and their learning behaviors provide an important dimension for examining the student-centered and learning-centered talent cultivation measures and diversified development in colleges and universities. Therefore, the combination of typical correlation analysis and cluster analysis of education data mining and its learning analysis provides a broader perspective for the determination of relevant factors of learning types and the exploration of learning behavior performance and learning rules. The author hopes that through the above analysis, higher education researchers can pay more attention to the problems related to students' mathematics learning ability.

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Guo-xing Dai, associate professor, master of software engineering, Department of mathematics and applied mathematics, School of science, Jiangsu University; No. 301, Xuefu Road, Zhenjiang City, Jiangsu Province, 212013.
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