

Survey on Current Situation of Undergraduates' Mathematics Learning in China

Lianhua Ning, Xiaomin He

School of Mathematical Sciences, Nanjing Normal University, China

Haiyue Jin

National Institute of Education, Nanyang Technological University, Singapore

The current situation of undergraduates' learning of mathematics in China is not optimistic. Knowing the undergraduates' status of mathematics learning is of great importance for the improvement of mathematics education at the university level. In this study, we implemented a survey with mathematics undergraduates from three different universities. The results show that the students' learning of mathematics was mostly passive. Only a small portion of the participants did self-directed learning-before class. The majority of the participants relied on their mathematics learning in lectures and reference materials rather than independent thinking. It seemed that their whole purpose of learning was to pass exams.

Key words: mathematics majors, undergraduate, learning situation, survey

Background

Higher education in China has moved from the elite education stage to the mass education stage. With the popularization of higher education, however, many negative effects have also appeared. For example, the undergraduates' proficiency now varies greatly, but, for decades, the mathematics curriculum in most Chinese universities has barely changed. This incongruity may be one of the very reasons for the undesirable performance of mathematics education at the university level in China. Such a situation seems more serious for normal university mathematics-majors. Knowing the current situation of undergraduates' mathematics learning especially that of the normal university mathematics majors', their difficulties in learning mathematics is of great value for the study on the effectiveness of mathematics education at the university level. This study aims to make a preliminary investigation of the current situation of undergraduates' mathematics learning.

Methods

Purpose of the Study

This study attempts to investigate the undergraduates' learning status from three aspects: preview before class, classroom learning, and after-class review. It tries to find the differences of the attitudes, learning methods, and learning outcomes among undergraduates of different achievement levels. Besides, it also aims to understand the influence of the students' problems or difficulties with mathematics learning on their mathematics learning outcomes.

Participants

The participants were mathematics majors from three different universities A, B, and C. The sample selection paid attention to the balance between male and female participants; hence, the findings in this study can exclude the effect from gender. Considering the fact that mathematics majors are mainly from normal universities, this study selected one non-normal university A and two normal universities B and C. A is a national level key university, B is a first-class university, and C is a second-class university. There were altogether 394 participants, of which 372 provided valid questionnaires. The response rate was 95.18% and the effective rate was 94.40%. The distribution of the participants is shown in Table 1.

Table 1
Distribution of Participants from the Three Universities

University	A	B	C
Number of participants	108	117	169
Number of questionnaires collected	93	117	165
Number of valid questionnaires	93	117	162
Ratio: Male to Female	44:49	48:6	73:89

9

Questionnaire

This study used an anonymous questionnaire for data collection. The items in the questionnaire were multiple-choice questions, including both imperative and optional ones. The questionnaires collected were reviewed and the invalid ones were excluded from data analysis.

The questionnaire contained a total of 12 items, of which eight were imperative and four optional. Item 1 to 3 focus on "preview before class".

They were designed to examine whether the participants could effectively carry out self-directed study before class. Items 4 to 6 focused on “classroom learning”. They were designed to investigate whether the participants could find the best suited learning method for their mathematics learning in class. Items 7 to 12 focused on “after-class review”. They were designed to examine whether the participants could find effective solutions when they encountered difficulties and whether they knew their strengths and weaknesses in mathematics learning.

Data Analysis

Preview before Class

Table 2 shows the percentages of the participants who did preview before class often, sometimes, or never in the three universities respectively. Table 3 reports the percentages of the reasons given by the participants that prevent them from preview before class.

Table 2

Percents of Participants Who Did Preview before Class Often, Sometimes, or Never

University	A	B	C
Often	26.5%	34.2%	12.4%
Sometimes	53.1%	57.3%	21.3%
Never	20.4%	8.6%	66.3%

Table 3

Reasons of Abnormal Preview

University	A	B	C
Unable to understand	6.9%	22.1%	23.6%
Having no time	33.3%	32.5%	25.7%
Having no need	23.6%	9.1%	17.6%
Others	25.0%	36.4%	21.6%

Concerning the “preview before class”, we have the following findings:

(1) Only a small portion of the undergraduates did preview often before class. As shown in Table 1, the total percentage of the participants who often previewed before class is 23.4%, while the total percentage of the participants who never previewed is 38.2%. This finding suggests that only a few undergraduates can really carry out independent study before class; most of them haven’t yet developed good habits of preview. Compared with

university A and B, the situation is more serious in university C. About 66.3% of the undergraduates in university C stated that they never previewed before class. Though another 21.3% of the participants indicated that they previewed sometimes, the quality of their preview is questionable.

The participants from the three universities are either freshmen or sophomores. Most of them may have not yet converted their roles from high school students to undergraduates. They are still used to the learning methods applied in high schools, e.g., focusing mainly on textbooks and/or relying on teachers' explanations. They have not realized the significance of self-study. However, at the university level, the scheduled hours of mathematics courses for mathematics-majors are generally 3-6 hours per week which is far less intensive than that of the mathematics lessons in high schools. Therefore, if the participants have not adjusted their learning habits accordingly, they may be unable to implement their knowledge into practice and their further study may also be affected greatly.

On the other hand, most of the participants who did preview often before class have already mastered the self-learning methods. As shown in Figure 1, an average of 79.3% of these participants could find knowledge elements that they were confused with, pose questions, and then bring the questions to their classroom learning. At the same time, the participants who did "blind preview" may become familiar with the new knowledge by browsing the textbook, even though they were unable to pose questions in their preview process. As a result, in comparison to the participants who did not preview the lessons, they could learn more from classroom lectures.

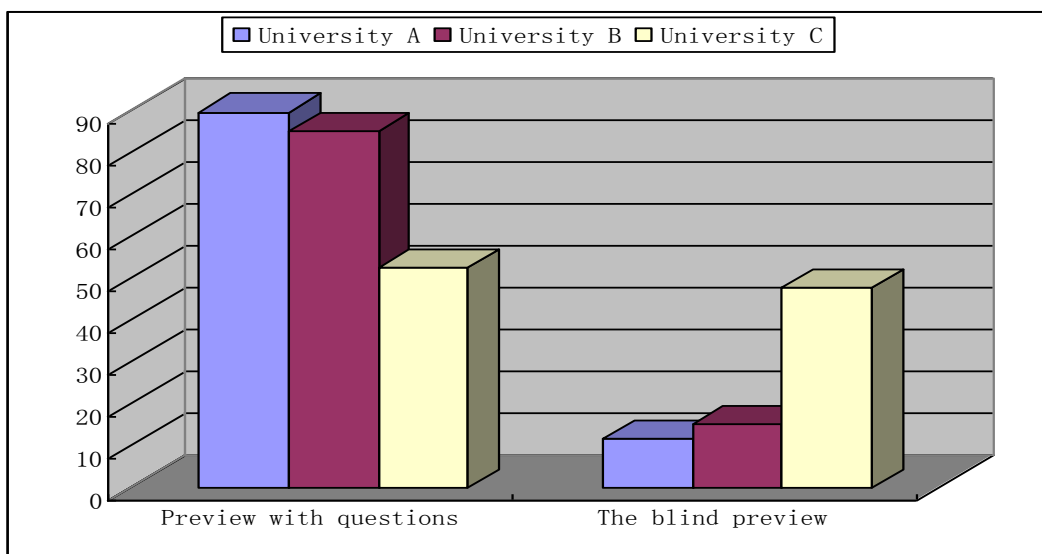


Figure 1. *Situation of students doing normal preview in three universities.*

(2) There are different reasons for the undergraduates' failing to preview before class; the main reason is that they did not realize the importance of preview for their mathematics learning. A close look into the participants' responses to the questionnaire reveals that, among the participants who never preview or only preview sometimes before class, about 30% indicated that they had no time to preview, and others stated that there is no need to spend time on preview. This shows that these participants have not realized the importance of preview, and did not even mention its advantages.

In addition, more than 20% of the participants from university B and C indicated that they gave up preview because they could not understand the learning materials. This number is about three times of that of the participants from university A. This indicates that, except for the difference of the undergraduates' achievement levels in the three universities, the readability, applicability, and difficulty of the textbooks may be the main reason for the difference in "preview before class" among the participants. Therefore, choosing teaching materials and scheduling lessons in accordance with students' aptitude should be the primary concern of course implementation in all universities.

Classroom Learning

Classroom learning is a process in which students' thinking and action interact with teachers' teaching. In this study, by interviewing some teachers and observing some classroom teachings, we found that there were few interactions between the teachers and students. Most students were busy with classroom notes; very few asked questions in class. Hence, this study also pays attention to the participants' note-taking in class.

Table 4 shows the percentages with complete notes, selectively, or never respectively in the three universities.

Table 4
Situation of Notes Taking in Class in the Three Universities

University	A	B	C
Taking notes completely	8.2%	11.1%	59.2%
Taking notes selectively	76.5%	86.3%	39.1%
Never take notes	15.3%	2.6%	1.8%

The results show that most participants took notes during lectures. It can be found from Table 4 that the majority of the participants in university A and university B took notes selectively. This is consistent with the findings about "preview before class". Compared with university C, fewer participants

in the two universities chose "never" preview; most of the participants previewed often or sometimes. This further suggests that preview before class can improve students' efficiency in class, help them find their own weaknesses, and strengthen their understanding of the newly learned knowledge.

Correspondingly, in university C, where fewer participants did preview before class, 59.2% of the participants indicated that one with complete notes; and among the participants who took notes, 51% stated that they took notes just because they did not preview before class. This finding indicates that these participants' learning of mathematics mostly relied on teachers' explanation and guidance rather than self-learning before and after class. Superficially, the completing notes means that the students listened carefully in class. But in a long run, this may result in a vicious cycle of negative mood. Supposing that there is no preview before class, it is challenging for the students to understand the newly learned knowledge while taking complete notes. Many students may hardly obtain full understanding of the knowledge and, consequently, they may feel anxious and panic with mathematics. Eventually, they may become reluctant to preview the next lesson.

In addition, this study finds that most participants took notes mainly because classroom notes are important materials for preparing for final examinations. This finding reveals the undergraduates' superficial motivation for learning. They may not be aware the use of the knowledge that they learned, and treat learning only as a way to get academic credits and certificates. They ignored the real purpose and meaning of mathematics learning.

After-class Review

Table 5 shows the percentages of approaches taken by the participants when they encounter difficulties or problems during learning.

Table 5
Approaches Taken by the Participants When Encountering Problems

University	A	B	C
Put aside first, think later	46.9%	35.9%	29.0%
Consult teachers or classmates	8.2%	6.0%	16.6%
Refer to standard answers	36.7%	57.3%	52.7%
Wait for teachers'	1.0%	0.9%	1.2%

explanation	%
-------------	---

The results show that:

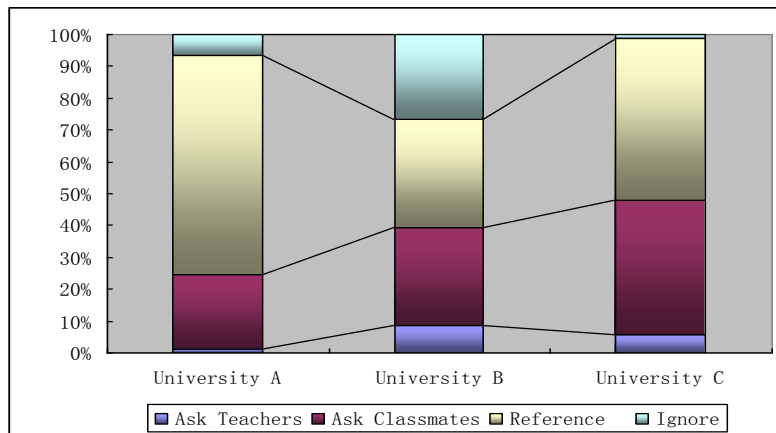
(1) The participants are over-dependent on reference materials; they lack the spirit of independent exploration. Table 5 shows that over half of the participants in university B and C preferred to refer to standard answers in the face of difficulties. These students were over-dependent on reference materials; they lacked the spirit of independent exploration. If they do not adjust their learning habits promptly, their future learning will be affected. As a result, the call for cultivating innovation capability will eventually become an empty call.

(2) There is rarely communication between teachers and students after class

Figure 2 shows the portions of solutions the participants chose when they encounter problems in class. It shows that most of the participants chose to refer to teaching materials or reference books; only a small portion chose to consult teachers.

It shows that, other than the interaction "teacher teaching, student listening" in class, there was no affective interaction between teachers and students, and their interaction after class was rare. This finding, from a different perspective, reflects that the teachers did not care enough about the situation of their students. They seldom took the initiative to communicate with students.

(3) The participants conducted review mainly for examinations.



This study finds that the participants conducted review mainly for examinations. Take the data of university A as an example (see Figure 3).

Only 17.6% of the participants did periodic summaries. About 58.2% did not review the lessons regularly; they normally leave it until examinations. Such a situation also exists at the other two universities, indicating that it is a common phenomenon among modern university students. They do not bother

to understand the what is taught and disregard the progress of failed or missed courses. They seem to only care about whether the notes are complete and whether they have covered the key points for the examination. This shows that the undergraduates did not have a clear motivation for learning and they had not realized the importance of the teaching of specialized courses. They simply equated learning with passing examinations, which is opposite from the purpose of the modern universities.

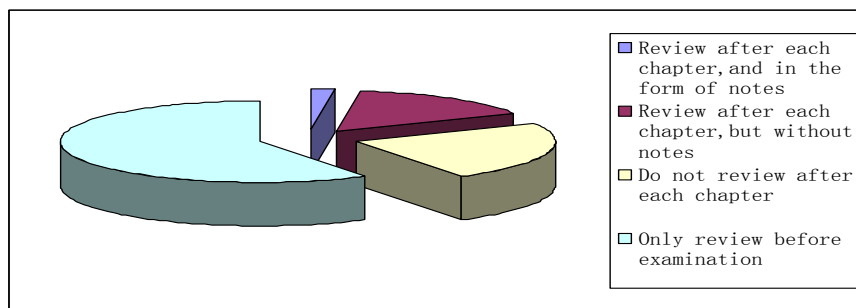


Figure 3. Review situation of student in university A.

Discussion

Choose Suitable Teaching Materials and Humanize Curriculum Design

The current situation of university mathematics education is closely related to the design of curriculum and also to the selection of teaching materials. It was noticed that the teaching materials used in the universities are quite different in difficulty levels although the contents are similar. Teachers should choose teaching materials in accordance with the overall quality of their students. The teaching materials should not be too difficult since mathematics itself at the university level is already abstract, complex, and esoteric. If the textbooks are difficult to read, the students may lose their appetite for learning. Moreover, since most of the mathematics majors in normal universities will work in a career related to elementary mathematics; obscure and detailed courses offer few benefits for their current learning and future work. Hence, such courses should be changed to those that are more relevant to elementary mathematics so as to help the students optimize their knowledge structure.

In addition to choosing appropriate teaching materials, teachers need also to prepare the lessons carefully and get to know their students' specific situations, especially the situations of first year students. Only with the understanding of both the teaching materials and the students, can teachers make a distinction between difficult and easy knowledge elements, spending

more time on difficult knowledge elements and less on easy ones. They should ensure that their students are able to understand the lessons; only then can the students' participation in class be guaranteed.

Dilute the Format of Test and Modify the Evaluation System

When freshman enter university, they often feel released from the high-pressured high school life. They tend to hold a wrong perception that it is not necessary to do well in examinations and they only need to pass them. With such a wrong perception, many students' mathematics learning is exam-orientated. They are busy with drilling for taking exams. The pursuit of knowledge is no longer the purpose of their study. Instead, it has degenerated into a mechanical activity. The students have lost the original meaning of study at a university.

In order to increase university students' enthusiasm for learning, some scholars proposed the idea of canceling examinations since they believe that examination results alone can hardly reflect the quality of students' learning. They argued that, if the exam-oriented learning behavior persists, in the long run, students will form the habit of overweigh exam results but neglecting the learning process. However, we should not ignore the usefulness of examinations. For a long time, it has been useful as a tool for measuring students' learning outcomes. Its directness in testing the curricular content and the convenience of its practice have determined the inevitability of its existence. The current examination system should not be removed; instead, it should be modified.

First, we should establish a rational and multivariate evaluation system. For example, we should include the usual grades as a part of the final score and adjust the proportion properly among usual grades, mid-term test score and final exam score. By doing so, the focus of mid-term exam and final exam will shift to the balance among the knowledge elements measured in the mid-term exam, final exam, and ongoing tests. This will force the students to pay attention to their everyday classroom study and actively become involved in the learning process.

Second, we can allow students to seek assistance during examinations by changing the close-book exam mode to semi-closed or even open mode. For example, we can allow students to bring a piece of reference paper to the examination. Teachers keep the right to decide the content and paper size of the reference paper. By doing so, the cheating phenomenon may be largely reduced; besides, this will help to achieve the purpose of quality-oriented education.

Strengthen the Communication between Teachers and Students

The schedule of university courses is less compact than that in high school. University teachers normally do both teaching and scientific research work; hence, students usually have few chances to meet their teachers after class. Teachers hope to make full use of the limited class time and help their students get as much knowledge as they can. As a result, the arrangement of class time is quite compact and almost no time is left for students to ask questions, which means it is difficult to increase the communication between teachers and students in class. But if teachers can make full use of the 10-minute recess time, or stay 10 more minutes after class, they can strengthen both the academic exchange and affective interaction with students, and help them to solve difficulties. In the long run, students may be able to appreciate the efforts teachers make and become more willing to share their feelings or difficulties in learning with their teachers.

Note: This study is supported by the fund of higher education in Jiangsu Province for the research topics: The practical modes and quality of research-oriented teaching of university mathematics (2011JSJG211) and the efficiency of university mathematics teaching (KT2011317).

References

- Guo, M. (2007). High colleges and universities algebra geometry curriculum conformity exploration and practice *Journal of Mathematics Education*, 16(4), 90-92.
- Hu, D. (2008). Researching into the curriculum reforms of higher normal mathematics education under the new policy background. *Journal of Mathematics Education*, 17(6), 78-81.
- Li, L. (2008) Research on teaching reform of mathematics teaching at higher teacher's college. *Journal of Mathematics Education*, 17(5), 87-90.
- Lou, Y. (2008). Lack and reconstruction of cultural point on the lesson of university mathematics. *Journal of Mathematics Education*, 17(3), 78-80.
- Lu, J. (2003). Causes and countermeasures for freshmen to learn mathematics "difficult period". *Modern Education Science*, 10(9), 115-116.
- Pi, L., & Yan, Z. (2010). Researches on the effects of the teacher-expectancy on the technical secondary school student's learned helplessness in mathematics study. *Journal of Mathematics Education*, 19(1), 44-47.
- Yu, J. (2005). Analysis and countermeasures of mathematics learning on future teachers. *Journal of Guangxi College of Education*, 20(4), 62-63.
- Zhang, S, Bao, J., & Wang, R. (2009) Quantitative analysis of learning motivation on influence factors of tuition-free mathematics normal

- university students. *Journal of Mathematics Education*, 18(6), 49-53.
- Zhang, X. (2010). Thinking about changing the beliefs of the normal school's pre-service mathematics teachers teach. *Journal of Mathematics Education*, 19(2), 15-18.
- Zhou, S. (2007). Applying peer direct to promoting ability of student teacher' learning. *Journal of Mathematics Education*, 16(4), 96-98.

Authors:

Lianhua Ning
Nanjing Normal University, China
Email: *ninglh@126.com*

Xiaomin He
Nanjing Normal University, China
Email: *sky0605hxm@126.com*

Haiyue Jin
Nanyang Technological University, Singapore
Email: *haiyue.j@gmail.com*