



Exploring the Habits of Taking Photos in Class among College Students Majoring in Mathematics

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

With the development of College teaching and learning, some students majoring in mathematics have switched to using electronic devices to take photos instead of notes for recording. The purpose of this research is to explore the causes of this phenomenon. Research on this phenomenon can help improve students' learning and teachers' teaching in class. The research method used in this study is the interview method and interviewees are the undergraduates majoring in mathematics who have the habit of taking photos in class. The conclusions drawn from this study are as follows: (1) Taking photos is not satisfactory for learning. (2) The phenomenon can be attributed to the following factors: In terms of students, firstly, their learning concept is utilitarian and their learning motivation is weak. Secondly, some students are lazy about taking notes on non-exam content. Thirdly, some students have difficulty understanding the knowledge in class. Lastly, taking notes by hand is not organized. In terms of teachers, their lectures are too fast and illogical. In other aspects, taking photos has the advantage of clarity and convenience. Furthermore, students who take photos will subconsciously motivate other students to take photos in class. Based on the above analysis, in order to improve this phenomenon, it is suggested to improve students' note-taking ability, change students' learning concepts and improve teachers' information-based teaching level.

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1. INTRODUCTION

The period of college is a golden time for students' individual development and knowledge reserve. Notes, as an outward form of students' thinking in class, are a means of helping students construct knowledge. It helps learners to summarise their learning in their own words and increase the depth of cognitive processing and understanding [1]. For students majoring in mathematics, their professional knowledge has the characteristics of logic and abstraction. Therefore, classroom notes play an important role in their learning. With the development of electronic devices, students majoring in mathematics have changed the way they record their notes in class. They have switched to using electronic devices to take photos instead of taking notes by hand. However, there are conflicting views on the effectiveness of recording notes by taking photos. Some people think that it is beneficial to learning, while others think that taking photos is not conducive to learning. Therefore, it is of great practical significance to explore the deep-rooted causes of the phenomenon of taking photos instead of taking notes in class among college students majoring in mathematics, which has practical implications for promoting students' learning in class as well as improving teachers' teaching.

The research question in this paper is: (1) What are the main causes of the phenomenon of taking photos instead of taking notes in class among college students majoring in mathematics? (2) Based on the results of the study, what are the countermeasures to improve the phenomenon of taking photos instead of taking notes of college students majoring in mathematics?

2. LITERATURE REVIEW

At present, scholars' research on the notes taken in class mainly contains four aspects, which are the functions of notes, ways of taking notes, the effect of teachers' instruction on students' note-taking and note-taking behavior. For research on ways of taking notes, previous studies have found that note-taking styles vary from person to person, and there are no advantages or disadvantages to different recording methods. American scholar Devine studied various note-taking methods such as underlining and column headings [2]. Walter Pauk invented the Cornell

note-taking method, which divides the notebook into three areas in order: a notes column, a hints column, and a summary column. His study concluded that this note-taking method better helps students to take good notes in class [3]. Kiewra proposed the linear technique and matrix technique, in which the linear technique involves sorting out major and minor headings based on what is taught in the classroom and then supplementing the notes based on the headings [4]. Yang proposed the 'conversion-association-reduction' note-taking method and pointed out that this method has a significant effect on the improvement of students' learning [5].

For research on the effect of teachers' instruction on students' note-taking, Einstein's study pointed out that students' note-taking was directly related to the speed of the teacher's lecture [6]. Long's study pointed out that if teachers provide students with classroom notes before the class, students will be more focused in class [7]. Gee, Karen L's study pointed out that if the teacher outlines the content of the lesson for the students before the lecture, it can reduce the time allocated to note taking and thus better participate in class [8]. Ray found that teachers' board teaching strategies have an impact on the development of students' note-taking habits [9]. Morton's study found that teachers' checking and guiding of notes after the class helped students develop good note-taking habits [10].

For research on the functions of notes, Fayol's study indicated that there was no direct correlation between note-taking and students' academic performance [11]. Fowler suggested that the use of note-taking facilitates students' learning and promotes their mastery of knowledge [12]. With the popularity of electronic devices, different research findings on the relationship between note-taking and academic performance have emerged. Aragon-Mendizabal found that the use of electronic devices for classroom note-taking can increase the speed of note-taking, but it is not effective in helping students understand the content of their notes [13]. Kim and Don-Han investigated the effect of note-taking with the help of mind maps and found that this method has a significant effect on improving students' classroom efficiency [14]. Al-Zaidi found that the development of social interactive note-taking to share notes with each other and assist students in improving their notes can significantly improve students' academic

performance [15]. Jackson found that note-taking with the help of digital note-taking devices can improve students' learning [16].

For research on note-taking behavior, Fan and Zhu explored the note-taking behavior of secondary school students in the context of psychology [17]. Zhu, Wang and Zhou revealed the textbook note-taking characteristics of students at different academic levels in terms of specific behaviors [18]. Chen pointed out that most college students take notes for the purpose of coping with exams [19]. Wang's study found that there is a direct relationship between learning effectiveness and classroom note-taking behavior and the quality of notes [20]. He found that today's fragmented access to information has led to a shift in the way college students take notes [21]. Luo found that the root cause of the postponement of the active learning process in college students is that most of the students could not feel the fun of the learning process [22].

By compiling and analyzing the study of classroom notes, the following conclusions were drawn. Firstly, most of the research on classroom note-taking is conducted at the high school and junior high school educational levels. There are few studies on the classroom note-taking behavior of undergraduates and none of them are specific to the classroom note-taking behavior of undergraduates majoring in mathematics. Secondly, most of the current research has been conducted at the theoretical level. There are more studies on the functions of note-taking and the ways of note-taking, but there is a lack of research on classroom note-taking at the practical level.

3. METHODS

3.1 Participants

This study was conducted on 30 college students majoring in mathematics who have the habit of taking photos instead of taking notes, including 11 males and 19 females. 6 in the first year, 4 in the second year, 7 in the third year, and 13 in the fourth year. 15 majored in Mathematics and Applied Mathematics, 3 majored in Data Science and Big Data Technology, 4 majored in Information and Computing Science and 8 majored in Statistics. The selection of interviewees considered the differences between genders, grades and majors. The research subjects were comprehensive and the interviewees had a good understanding of their note-taking style, so the data collected from the

interviews could provide a reliable basis for this study. Details of the survey sample are shown in Table 1.

3.2 Instrument

3.2.1 Test questions

The interview outline started with the curriculum and content of photos to understand the current situation of taking photos in class. After that, five questions were compiled from the dimensions of teacher factors, student factors, and other factors of taking photos to find out the multifaceted causes of taking photos in class. Finally, the interview questions were designed from the effects of taking photos to come up with the effects of taking photos on the learning of Mathematics students.

3.3 Data Collection

In this study, college students majoring in mathematics who have the habit of taking photos in class are recruited as interviewees, and the interviewees were screened to make the interview data more representative. After contacting the interviewees in advance, we conducted semi-structured interviews with them according to the interview outline and recorded them. Finally, a total of 30 interview data were collected.

3.4 Data Processing

After the interview, the interview data were processed as follows: First, the interview recording of each interviewer was converted into text, and then the data obtained from the interview was encoded. Finally, the coding results were sorted out statistically.

4. RESULTS

4.1 The Current Situation of Taking Photos in Class

When someone asks, "What classes do you take the most photos of?" Most students claimed to have taken the most pictures in their math major classes; a small percentage claimed to have taken the most pictures in the challenging classes; still others claimed to have taken the most pictures in their public classes and the final class of the semester; still others claimed to have taken the most pictures in classes that required a lot of group work and at the start of the semester. The statistical results of the survey are shown in Table 2.

When asked, "What content do you take the most photos?" It was found that most of the students took the most photos when the teacher emphasized the key contents and the contents that would be tested in the examination. Many students stated that if they had to record something that took a long time or was hard to understand in class, they would prefer to snap pictures. When the teacher went over the theorem derivation procedure and the parts that weren't in the textbook, a select few pupils snapped the most pictures. Just a tiny percentage of students claimed to have taken the most pictures of the evaluation techniques used in the course. The statistical results of the survey on the type of content to be photographed are shown in Table 3.

4.2 Learning Effect of Taking Photos instead of Taking Notes

The vast majority of the students thought that there were advantages and disadvantages of taking photos, while some others said that the results were average and not very good. Only a small number of students thought that taking photos was effective. A very small number of students said that the effectiveness depends on whether they organize them after class. The statistical results of the survey on the effect of taking photos and recording are shown in Table 4.

4.3 Personal Factors Leading to Photographic Records

In response to the question, "Why didn't you choose to take notes with a pen?" "What are your own factors that led you to choose to take photos instead of taking notes?", the majority of the students thought that taking notes with a pen was not comprehensive enough and it was easy to miss the content. Most of the students said that the teacher's teaching content was not easy to understand in class so they chose to take photos to learn after class. Most students thought that they chose to take photos to record their notes because they were lazy. Some students thought that it was difficult to keep up with the pace of lectures, and mobile phone photos could record a lot of information in a short time, which was convenient and quick. A small number of students said that they sometimes could not see the blackboard, and the mobile phone photos were very clear. This is also an important reason why they choose to take photos. A small number of students also thought that taking photos with mobile phones could be viewed at any time, and the content recorded with a pen was not accurate enough, which led them to choose to take photos. In addition, a very small number of students chose to take photos because their handwriting was scribbled and not organized enough. The statistical results of the survey on the personal factors of taking photos and recording are shown in Table 5.

Table 1. Survey Sample Situation

| Category | | Number | Percentage |
|----------|--------------------------------------|--------|------------|
| Gender | Male | 11 | 36.67 |
| | Female | 19 | 63.33 |
| Grade | Freshman | 6 | 20.00 |
| | Sophomore | 4 | 13.33 |
| | Junior | 7 | 23.33 |
| | Senior | 13 | 43.33 |
| Major | Mathematics and Applied Mathematics | 15 | 50.00 |
| | Data Science and Big Data Technology | 3 | 10.00 |
| | Information and Computing Science | 4 | 13.33 |
| | Statistics | 8 | 26.67 |

Table 2. Coding Results for Types of Photographic Sessions

| Code | Details | Number | Percentage |
|------|--|--------|------------|
| A1 | Lessons with lots of group work | 1 | 3.33 |
| A2 | Mathematics Speciality Courses | 29 | 96.67 |
| A3 | Classes at the beginning of the semester | 1 | 3.33 |
| A4 | Classes at the end of the semester | 2 | 6.67 |
| A5 | Every lesson | 1 | 3.33 |
| A6 | public course | 2 | 6.67 |
| A7 | Lessons with learning difficulties | 1 | 3.33 |

Table 3. Types of Photographic Content

| Code | Details | Number | Percentage |
|------|--|--------|------------|
| B1 | Key points emphasised by the teacher | 11 | 36.67 |
| B2 | Theorem derivation process | 3 | 10.00 |
| B3 | Coursework assigned by the teacher | 2 | 6.67 |
| B4 | Content which is not mentioned in the textbook | 5 | 16.67 |
| B5 | Content that will be tested in exams | 9 | 30.00 |
| B6 | Content that takes a long time to record | 9 | 30.00 |
| B7 | Content that is difficult to understand in class | 11 | 36.67 |
| B8 | Assessment of the course | 1 | 3.33 |

Table 4. The Effect of Taking Photos

| Code | Details | Number | Percentage |
|------|--|--------|------------|
| C1 | There are advantages and disadvantages | 9 | 30.00 |
| C2 | Effectiveness depends on whether you organize yourself after class | 1 | 3.33 |
| C3 | Effective | 5 | 16.67 |
| C4 | Not very effective | 8 | 26.67 |
| C5 | Fairly good | 7 | 23.33 |

Table 5. Individual Factors in Photographic Records

| Code | Details | Number | Percentage |
|------|--|--------|------------|
| D1 | Pen records is insufficiently comprehensive and easy to miss the key points | 17 | 56.67 |
| D2 | Existence of lazy mentality | 13 | 43.33 |
| D3 | Pen records is not accurate enough and is prone to pen errors | 1 | 3.33 |
| D4 | Difficult to keep up with the pace of the lecture when taking notes with a pen | 9 | 33.33 |
| D5 | Difficult to see the blackboard, but mobile phone photos are clear | 3 | 10.00 |
| D6 | Mobile phones can record a lot of information in a short time, which is convenient and fast. | 9 | 30.00 |
| D7 | It is not necessary to take notes because it is easy to get high grades | 8 | 26.67 |
| D8 | Notes are scribbled and not well organised. | 2 | 6.67 |
| D9 | The study habit is to understand the knowledge in class and organise notes after class | 3 | 10.00 |
| D10 | Teaching content is not understood in class so take photos to learn again after class | 17 | 56.67 |
| D11 | Phone photos can be viewed at any time | 1 | 3.33 |

4.4 Teacher Factors Leading to Photographic Records

In response to the question "Why didn't you choose to take notes with a pen?" "Do you think the teacher's style of lecturing and the way of teaching had an influence on your choice to take photos?", the vast majority of the students thought that the speed of the teachers' lecture was too fast and it was difficult for them to keep up with the pace of the lecture, so they choose to take photos. Most of the students said that the

teacher's explanations were abstract and difficult to understand, which made it difficult for them to comprehend, leading them to choose to take photos for notes. Some students said that the teacher would not leave time for students to take notes. Some other students thought that the teacher's lectures were different from the textbook, so they needed to record a lot of notes. A small number of students choose to take photos because their teachers do not provide class materials after class, the content of the lectures is different from the textbook. A very

Table 6. Teacher factors in photographic records

| Code | Details | Number | Percentage |
|------|--|--------|------------|
| E1 | Some teachers guide students to take photos to record notes | 1 | 3.33 |
| E2 | The speed of the lecture is too fast and it is difficult to keep up with the pace of the lecture. | 16 | 60.00 |
| E3 | Teachers do not provide courseware after class | 3 | 10.00 |
| E4 | Teacher's pronunciation is not standard, unable to understand the content of the lecture | 1 | 3.33 |
| E5 | Teacher's writing is not clear | 4 | 13.33 |
| E6 | Teacher's lectures are different from the textbook, so you need to take a lot of notes. | 6 | 20.00 |
| E7 | Too many words in the PowerPoint, difficult to record in a short period of time | 6 | 23.33 |
| E8 | The teacher reads from the textbook, which makes the students unable to participate in the class | 4 | 13.33 |
| E9 | The teacher does not leave time for students to take notes | 8 | 26.67 |
| E10 | Teacher's explanations are abstract and difficult to understand, making it difficult to comprehend | 12 | 40.00 |

Table 7. Other factors in photographic records

| Code | Details | Number | Percentage |
|------|---|--------|------------|
| F1 | Maths knowledge is abstract and difficult to understand in class | 2 | 6.67 |
| F2 | Whether the teacher's classroom management is strict | 2 | 6.67 |
| F3 | The development of technology drives changes in classroom recording | 3 | 10.00 |
| F4 | Influence of surrounding classmates | 10 | 33.33 |
| F5 | No other factors | 13 | 43.33 |

small number of students also said that some teachers would even guide students to take photos to record. The statistical results of the survey on the teacher's factor of taking photographs and records are shown in Table 6.

4.5 Other Factors Leading to Photographic Records

In response to the question "Why don't you choose to take notes with a pen?" "In addition to the two factors of teachers and students themselves, what other factors do you think led you to choose to take photos?" the majority of the students thought that the teacher's factor and their own factor were the main factors, and other factors had no influence on whether they choose to take photos. The majority of the students said that they are influenced by the students around them. Some students thought that the development of information technology influenced their choice of taking photos to take

notes. A small number of students thought that mathematical knowledge was abstract and difficult to understand in class, so they chose to take photos to take notes. A very small number of students also said that whether they took photos or not depends on the teacher's classroom management. The survey statistics of other factors of taking photos to record notes are shown in Table 7.

5. DISCUSSION

5.1 Learning Effect of Taking Photos Instead of Taking Notes

The results of the interview revealed that only a small number of students thought that taking photographs was good for learning, and most of them could not make good use of taking photos to assist their learning. In conclusion, taking photographs was not effective for learning.

5.2 Personal Factors that Lead to Taking Photos instead of Taking Notes

5.2.1 Utilitarian Concept of Learning

Most of the mathematics majors choose to take photos in their professional classes and their photo content is mostly focused on the exam. Many students think that it is not fast enough to record the content with a pen, and they are always worried that they will miss the key content of the exam, so they choose to take photos to record it. It can be seen that many mathematics majors have a very utilitarian concept of learning. This leads students to pay too much attention to the key points of the exam. And taking photos can record the examination focus comprehensively in a short time, which also leads to the mathematics majors choosing to take photos to record the examination focus.

5.2.2 Weakness of Learning Motivation

Taking notes is a kind of learning behavior, which needs to be guaranteed by a certain learning motivation. According to the above statistics, many mathematics majors said that they chose to take photos because they had a lazy mentality, thinking that it was too tiring to take notes with a pen. Furthermore, it is not difficult to find that many students' academic pressure is small and it is easier to pass the course, which leads to the weakening of many students' learning motivation. They don't pay enough attention to taking notes and are too lazy to take notes in class.

5.2.3 Difficulty in comprehending the teacher's lectures in class

From the above statistics, it is found that the vast majority of students take the most photos in the mathematics major class, and most of them will choose to take photos of what they have difficulty understanding in class. Through interviews, the author found that many mathematics majors have difficulty digesting the content of the teacher's explanation in class. Many students find it especially difficult to learn the derivation and proof of theorems, and it is difficult for them to follow the teacher's ideas in class. Therefore, they choose to take photos to record them first, and then study them after class.

5.2.4 Lack of note-taking skills

The above statistics show that some students feel that their handwriting is scribbled and not

organized enough, so they are reluctant to take notes with a pen. Many students think that they have to take notes on whatever the teacher says, fearing that they might miss a word. Therefore, many students' notes are almost a copy of the teacher's coursework. They neglected the fact that note-taking lies in the reinforcement of core ideas. As a result, many students' note-taking ability is deficient, which directly leads to the fact that it is difficult for them to keep up with the pace of the teacher's teaching by taking notes with a pen, and they are eventually forced to choose to take photos to record their notes.

5.3 Teacher Factors that Lead to Taking Photos instead of Notes

5.3.1 Constraints on teachers' pedagogical capacity

The results of the interviews showed that most of the students chose to take photos to record their notes, mainly because the teacher's lectures were too fast-paced and it was difficult for students to keep up with the pace of the lectures by taking notes. Some students also thought that the teacher did not leave time for note-taking in class. It can be seen that the teacher's pace of lecture has an influence on whether students choose to take notes with a pen.

The second is the logic of the teacher's lectures. A logical and organized class helps students to grasp the structure and main lines of the content. The results of the interviews showed that most of the students thought that they would choose to take photos when the teacher's explanations were abstract and difficult to understand, making it difficult for them to comprehend. A small number of students said that when the content of the teacher's lectures is different from the textbook, they need to take a lot of notes, and they would tend to take photos to record them. It can be seen that the logic of the teacher's lectures has an important influence on whether students take notes or not.

5.3.2 Teachers' classroom management

The interview statistics show that when the teacher's classroom management is strict and students are not allowed to use mobile phones in class, students will choose to take photos to record their notes. On the contrary, some students said that their teachers knew that they

were not keen to listen in class, and when coming to some important content, their teacher would guide them to take photos to record notes, thus letting students develop the habit of taking photos subtly. It can be seen that teachers' classroom management also has a certain influence on whether students choose to take photos to record their notes.

5.4 Other Factors that Lead to Taking Photos instead of Taking Notes

5.4.1 Development of information technology

Mobile phone can record a large amount of information in a short time, which is convenient and fast. What's more, mobile phone photo records can be looked over anytime and anywhere. It can be seen that with the development of the times, the mobile phone has become a convenient tool for note-taking. Many students feel the convenience of taking photos and thus choose to take photos instead of taking notes.

5.4.2 Influence of peers

Through the interviews, many students believed that the students around them had a subtle influence on them. Many students saw that the students around them were taking photos of certain content and worried that they would miss the key points, so they followed this trend and chose to take photos. Therefore, whether they choose to take photos to record their notes is also related to the note-taking behavior of the students around them.

6. CONCLUSION

6.1 Conclusions of the Research

Taking photos to record is not effective. Most of the students can not make good use of taking photos to assist their study. The causes of photo-taking instead of note-taking for mathematics undergraduates include teacher factors, student factors, and other factors. Student factors include four aspects: utilitarian concept of learning, weakening of learning motivation, difficulty in understanding classroom content on the spot, and lack of note-taking ability. Teachers' factors include the constraints of teaching ability and teachers' classroom management. Other factors include the development of information technology and the influence of peers around them.

6.2 Countermeasures and Suggestions

6.2.1 Enhancing Students' Note-taking Skills

Electronic devices taking photos provide students with unprecedented ease of access to teaching resources. Therefore, the cultivation of students' note-taking ability becomes more and more important. In the author's opinion, for college students, lectures on how to take notes should be carried out, selection and exhibition activities of excellent notes should be held, and teachers should consciously teach students scientific note-taking methods in class.

6.2.2 Reversing students' concept of learning

Many students have not set up a correct concept of learning, thinking that learning is only to cope with examinations. Therefore, students majoring in mathematics should be helped to cultivate appropriate learning motivation. Schools should carry out teaching reforms, change the view of teaching which is mainly based on the transmission of knowledge, strengthen the connection with society, let students have more contact with social practical activities, and stimulate students' desire to actively explore knowledge in practical activities.

6.2.3 Enhance the level of informatisation teaching of college teachers

Many college teachers do not have a special systematic study of education and teaching theory. Some of them lack language expression ability, and some of them have poor teaching organization ability. All of these affect classroom teaching to a certain extent, which in turn leads to students' difficulty in understanding classroom content. Therefore, it is necessary to strengthen the post-service training of teachers and improve the level of informatization teaching of college teachers.

7. DEFICIENCY AND PROSPECT

The shortcomings of this study are as follows: Firstly, this study qualitatively analyses the causes of taking photos through the interview method. The sample size of this study is limited, and more research subjects can be selected in subsequent studies. Secondly, the interview method is subjective and has some limitations, and the subsequent study can combine quantitative research with qualitative research.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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