

# *Investigation of Academic Procrastination Based on Time-Inconsistent Preferences and Urban-Rural Differences*

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**Abstract:** Most students experience learning-related procrastination that is more or less the result of spending time having fun. Although researchers have explored and researched the influencing factors and internal mechanisms of this phenomenon, due to the diversity of students' reasons for procrastinating, the measures used in this context have often encountered problems. In this paper, the current situation of students' academic procrastination and possible solutions to this problem are investigated and analyzed, and data are collected from 711 questionnaire surveys. Using the time-inconsistent preferences model, the degree of procrastination and time preferences of the interviewed students in different regions are calculated and analyzed, and the correlations among time-inconsistent preferences, urban-rural differences and respondents' degree of procrastination are identified. A polynomial fitting model that exhibits good correlation and accurately reflects the relationships among these factors is designed. Finally, the analysis results are summarized, and a hierarchical incentive mechanism is suggested, which provides a novel idea and an effective method for helping students overcome procrastination.

## **1. Introduction**

Procrastination refers to the negative behavior of continuously delaying the implementation of a plan to avoid problems despite knowing that doing so may have adverse consequences. Procrastination is common among all ages and groups in contemporary society [1-2]. Academic procrastination refers to situations in which students intend to complete a learning task but delay beginning the task or procrastinate during the process of completing the task, thus causing the learning task to be completed in a hurry to meet the deadline or not to be completed at all within the specified time. Academic procrastination often leads to poor emotional experiences, which not only affect students' learning efficiency and academic performance but also cause them to tend to develop poor study habits.

Due to the development of behavioral economics, the theories and methods associated with time-inconsistent preferences have been integrated into many fields of application [3-5]. However, answers to the question of whether students, who lack both social experience and a mature

understanding of the economy, have general time preferences similar to those of adults are not consistent, which requires further research and analysis. Accordingly, on the basis of drawing from a variety of questionnaires, a student academic procrastination questionnaire was designed. Students from different regions, such as the cities of Beijing, Shijiazhuang, and Zhangjiakou as well as the counties of Zhangbei and Guyuan, were selected as respondents. By investigating the current situation of students' academic procrastination across these different regions, we hope to determine whether urban-rural differences have a significant impact on students' procrastination.

The background and motivation of the paper are introduced in the first section. The technical status of students' academic procrastination and related solutions are analyzed in the second section. In the third section, a set of questionnaires that can fully reflect time preference and procrastination is designed, and 711 valid data points are collected via questionnaires. Subsequently, the time-inconsistent preferences and degree of procrastination of students from different regions are statistically analyzed, and a polynomial fitting model is established with respect to the relationship between degree of procrastination and academic satisfaction. Finally, the experimental results of the paper are summarized, and a hierarchical incentive mechanism that is convenient for practice is provided to help individuals overcome procrastination.

## 2. Current research on academic procrastination

Procrastination behavior is generally perceived to be a problematic phenomenon that leads to difficulties in time management and organization, low scholastic achievement, distraction, and a conspicuous gap between intention and action. Procrastination has been associated with low conscientiousness as well as a failure of self-regulation, fear, and performance anxiety (Steel & Klingsieck, 2016)[6]. It has also been associated with stress, poor mental health, poor cognitive functioning, and a tendency to reject therapy when facing emotional problems. Academic procrastination is expressed mainly in the context of academic tasks such as completing homework, writing papers, and studying for exams. It can also be associated with areas that are not directly related to academic studies, such as dissatisfaction with social relationships, sleep problems, irritability and anger, a sense of guilt, anxiety, and stress[7], and negatively associated with students' psychological well-being[8].

The earliest research on procrastination was conducted by Euis and Kuaus in the late 1970s. Subsequently, scholars such as Lay (1986), Tuckman (1991) and Milgram (1998) also employed a wide variety of theoretical and experimental psychological methods to investigate this topic. Research conducted by Piers, Thomas & Catherine[9] demonstrated that procrastination can negatively affect students' grades and personal emotional, physical and intellectual health. Moreover, according to statistics, 95% of students consciously delay the completion of tasks, and 70% of students do so frequently.

Questionnaires and assessments are the most commonly used methods in research on procrastination. Many survey and assessment tools have been used to research and analyze academic procrastination, such as the "General Procrastination Scale" compiled by Lay, the "Procrastination Assessment Scale-Student" compiled by Solomon and Rothblum, and the "Tuckman Procrastination Scale" compiled by Tuckman. Surveys are a mainstream method used to study academic procrastination, and the content of such surveys often varies in terms of method, including by focusing on age, gender, region, and a variety of other factors. In this paper, we mainly explore the internal correlations that lead to academic procrastination in terms of two main aspects: urban-rural differences and time preference. Time preference is a basic assumption in microeconomics; it reflects the consumer's preference for commodities and can be used to explain the differences between consumers' current preferences and those they will exhibit in the future;

that is, most individuals have time-inconsistent preferences [10,11]. The urban–rural difference is a common problem in contemporary society, and it is also one of the main factors leading to deviations in individual behavior. The literature [12,13] has shown that family education investment is an important mechanism underlying the stratification of urban and rural education in China. Studies have also found that the total expenditure for children’s education in urban households during the period of compulsory education is higher than that found in rural households, and the gap between these two groups in terms of extraschool tutoring expenditure is even greater.

In this paper, a model of time-inconsistent preferences is proposed to calculate and analyze the time preferences of students in different regions and to explore the relationships among respondents' time-inconsistent preferences, locations and degree of academic procrastination.

### 3. Analysis of academic procrastination based on time-inconsistent preferences and urban–rural differences

#### 3.1. Hyperbolic discounting model

The discounted utility model was proposed by Paul Samuelson in his paper "A Discounted Utility Measurement of Utility" in 1937 [14]: this model is also referred to as the DU model. The most important feature of the DU model is that it assumes that the time preferences of agents are consistent; however, as behavioral economics and experimental economics have developed, it has been proven that the time preferences of most agents are often inconsistent. For example, people usually like to spend time having fun, and even if the loss of current consumption can lead to greater benefits later, people still prefer to procrastinate with respect to unpleasant work or tasks. The actual data show that the discount rate is not static but decreases over time. In this way, when we use the DU model to analyze data, there is a certain deviation from the actual behavior of the agent.

Accordingly, Loewenstein & Prelec [15] proposed a well-known model—the hyperbolic discounting model. The hyperbolic discounting model can be used to explain inconsistencies in the agent's time preference very well, but it is very difficult to apply the hyperbolic discounting model. Therefore, in practice, most economists use a simplified model that is suitable for discrete calculation [16], that is, the semihyperbolic discounting model, as shown in Equation (1):

$$U(t, s) = u_t + \beta \sum_{s=t+1}^{\infty} \delta^{s-t} u_s \quad (1)$$

In this formula,  $U(t, s)$  is the utility function and  $u_t$  is the immediate utility of the agent at time  $t$ . In this model, the discount factor structure of the agent at each moment is set as  $\{1, \beta\delta, \beta\delta^2, \beta\delta^3, \dots\}$ . It can be seen that the long-term discount factor used by the agent between the future period  $t$  and the period  $t+1$  (long-term) is  $\delta$ , and the short-run discount factor between now and the first period (short-term) is  $\beta\delta$ .  $\beta$  is used to describe the self-control cognitive bias (known as the cognitive bias factor) of the agent in the context of short-term discounting. When  $\beta = 1$ , the short-term discount factor is equal to the long-term discount factor, and the semihyperbolic discount model degenerates into an exponential discount model (DU model), which returns to the assumption of classical economics, i.e., that the agent has no cognitive bias and exhibits consistent time preferences. When  $\beta \neq 1$ , this fact indicates that the agent does exhibit cognitive bias, and the long-term discount rate is different from the short-term discount rate, which may lead to abnormal behavior. In this context,  $\beta < 1$  represents a cognitive bias with insufficient

self-control, while  $\beta > 1$  represents a cognitive bias with excessive self-control. At present, in behavioral economics research, the mainstream position holds that agents have insufficient self-control cognitive bias, that is, in most cases  $\beta < 1$ , and the discount factor structure of "short-term low, long-term high" (or the "short-term high, long-term low" discount rate) is reflected in people's behavior, indicating the overconsumption and hedonic behavior of agents who are generally susceptible to short-term temptations.

Since  $0 < \beta < 1$  in general,  $\beta\delta < \delta$ , that is, the short-term discount factor is smaller than the long-term discount factor. Accordingly, the short-term discount rate is higher than the long-term discount rate, which also reflects such a law: the patience of the agent decreases with time, that is, the time preferences of the agent are inconsistent. In intertemporal discount research, most economists have chosen to use a semihyperbolic discounting model to simplify their calculations. In this paper, the relationship between students' time inconsistency preferences and procrastination is also investigated based on a semihyperbolic discounting model.

### 3.2. Design of the procrastination questionnaire including time preferences

Table 1: Questionnaire and its main items

Type	No.	Questions content	Objective
Basic information	1	What is your age?	Two demographic variables.
	2	What is your gender?	
Level of procrastination	3	Do you procrastinate or have you ever procrastinated?	By investigating the severity of students' procrastination in these subdivided areas, the survey results can provide a basis for evaluating the related variables that affect procrastination and analyzing the relationship between procrastination and time preference.
	4	How much do you procrastinate when reviewing for exams? (0-10; 0 indicates no procrastination, 10 indicates extreme procrastination)	
	5	How much do you procrastinate when doing your daily homework?	
	6	How much do you procrastinate when attending school activities?	
	7	What do you usually do while procrastinating?	
	8	How do you deal with challenging tasks?	
Academic performance	9	How often do you usually make a decision when faced with a difficult situation?	To provide basic data for analyzing the relationships among students' procrastination, time preferences and academic performance satisfaction.
	10	Are you satisfied with your academic performance?	
Time preferences	11	Which method do you think is most helpful in overcoming procrastination?	To determine whether students' preferences are skewed by due the addition of time discounting.
	12	Choose one of the two: ¥500 today or ¥510 a month later.	

The key aim of questionnaire design is to obtain accurate feedback to well-designed questions from a large group over a short period of time. To analyze the impact of inconsistent time preferences on academic procrastination and to avoid situations in which respondents abandon or falsely answer questions, which could lead to a decrease in the reliability and validity of the survey results, this paper adopts the objective classification method and designs a questionnaire featuring clear objectives and an appropriate number of questions to ensure the validity of the survey results.

The questionnaire contains four types of questions, each of which includes multiple items aimed at clear research objectives. The specific design ideas of and main items included in the

questionnaire are shown in Table 1. To save time and cost, this survey employs the method of online distribution. Participants in the survey were middle school students and college students. A total of 728 questionnaires were received. After excluding invalid answers, a total of 711 valid questionnaires were obtained.

### 3.3. Analysis of the time-inconsistent preferences of students in different regions

Among the 711 questionnaires collected, for questions no. 14 and no. 15, the interviewed students were asked to answer the following question: "How much money do you think ¥100 today will be equivalent to in one month and one year?". Table 2 shows the average results calculated for the answers of the interviewed students.

Table 2: Statistical mean of survey data for questions 14 and 15

Date	Now ( $m_0$ )	One month later ( $m_1$ )	One year later ( $m_2$ )
<b>Expected amount (¥)</b>	100	109.86	122.43

The expected values for now, one month later, and one year later are defined as  $m_0, m_1$  and  $m_2$ , respectively, and these values are shown in Table 2.

According to the semihyperbolic discounting model, the structure of the discount factor is  $\{1, \beta\delta, \beta\delta^2, \beta\delta^3, \dots\}$ , where the long-term discount factor is  $\delta$ , the short-term discount factor is  $\beta\delta$ , and the cognitive bias factor is  $\beta$ . Therefore, Formulas (2) and (3) are used to calculate the expected amounts for one month and one year (12-month) later, respectively.

$$\beta\delta \times m_1 = m_0 \quad (2)$$

$$\beta\delta^{12} \times m_2 = m_0 \quad (3)$$

If the values of  $m_0, m_1, m_2$  in Table 2 are included in Formulas (2) and (3), then the long-term discount factor  $\delta = 0.99$ , the short-term discount factor  $\beta\delta = 0.9109$ , and the cognitive bias factor  $\beta = 0.9201$  can be calculated in turn, as shown in Table 3.

Table 3: The overall discount factor and cognitive bias factor of the students

	Long-term discount factor $\delta$	Short-term discount factor $\beta\delta$	Cognitive bias factor $\beta$
<b>Results</b>	0.9900	0.9109	0.9201

Since  $\beta$  is less than 1, generally speaking, students remain short-sighted, i.e., they only care about their current interests and do not take long-term interests into account. In addition, on the 12th question of the questionnaire, the interviewed students were asked to choose between "A, I will give you 500 yuan today" and "B, I will give you 510 yuan in a month." In response to this question, 67% of people chose answer A; that is, they wanted to have 500 yuan immediately rather than waiting a month for an extra 10 yuan.

With respect to question no. 13 of the questionnaire, as part of which the respondents were asked to choose between "A, I will give you 1,000 yuan in one year" and "B, I will give you 1,100 yuan in one year and one month", 55% of respondents chose B; that is, more people were willing to wait an extra month for more benefits.

More people chose answer A with respect to question 12, but it is obvious that most people

chose B with respect to question 13. Accordingly, in the near future, most people feel that 10 yuan is not worth waiting an extra month, but when the timeframe is changed to a year later, more people are willing to wait for an extra month in exchange for an extra 100 yuan in income. This result further shows that students' preferences change due to the addition of time discounting factors, and this reversal of preferences also shows that students' time preferences are inconsistent. Comparing these two results, we can clearly see that the short-term discount rate (which is inversely proportional to the discount factor) is higher than the long-term discount rate and that students' time preferences exhibit a downward trend with time; that said, the student body also tends to spend time having fun.

In the literature [17], the urbanization quality of 286 cities in China has been evaluated and clustered, and cities have been divided into four types in accordance with their urbanization quality: good, medium, average, and poor. In this paper, referring to the methods discussed above and based on the IP addresses associated with the questionnaires, the respondents' regions are divided into four different development levels: Beijing, Shijiazhuang, Zhangjiakou, Guyuan County and Zhangbei County. Among these locations, Beijing is an example of good urbanization quality, Shijiazhuang City is an example of medium urbanization quality, Zhangjiakou is an example of average urbanization quality, and Guyuan County and Zhangbei County are examples of poor urbanization quality. The level of development in these four regions decreases the order just listed.

Based on these groupings, the data of each group's answers to question no. 14 and question no. 15 were counted, and the results are shown in Table 4 below. Simultaneously, when using the data in Table 4 alongside Formulas (2) and (3), the long-term discount factor  $\delta$ , the short-term discount factor  $\beta\delta$ , and the cognitive bias factor  $\beta$  of each group can also be calculated, and the specific results are shown in Table 5.

Table 4: Survey statistics for questions 14 and 15 by regional group

	Now ( $m_0$ )	One month later ( $m_1$ )	One year later ( $m_2$ )
Expected amount of the good city (Beijing) group (¥)	100	110.18	122.20
Expected amount of the medium city (Shijiazhuang) group (¥)	100	109.92	122.26
Expected amount of the average city (Zhangjiakou) group (¥)	100	109.42	120.33
Expected amount of the poor city (Guyuan and Zhangbei) group (¥)	100	109.96	124.01

Table 5: Discount factor and cognitive bias factor for each regional group

	Long-term discount factor $\delta$	Short-term discount factor $\beta\delta$	Cognitive bias factor $\beta$
Good city (Beijing) group	0.9906	0.9076	<b>0.9162</b>
Medium city (Shijiazhuang) group	0.9904	0.9098	0.9186
Average city (Zhangjiakou) group	0.9914	0.9139	0.9219
Poor city (Guyuan and Zhangbei) group	0.9891	0.9094	0.9194

According to the statistical results shown in Table 5, the results of the calculation of the discount rate and discount factor of each regional group are provided in Table 6. With respect to the good city (Beijing) group, the long-term discount factor  $\delta = 0.9906$ , the short-term discount factor  $\beta\delta = 0.9076$ , and the cognitive bias factor  $\beta = 0.9162$ . Among the four regional groups, the  $\beta$  value of the good city (Beijing) group is smallest, indicating that students in the Beijing group exhibited the most severe shortsightedness, while the students in the average city (Zhangjiakou)



group performed the best in this context.

### 3.4. Correlation analysis of students' time-inconsistent preferences and procrastination in different regions

In questions 4 to 6 of the questionnaire, the respondents were asked to answer the following question: "If procrastination is divided into eleven grades, such that the 0<sup>th</sup> grade indicates never procrastinating, the degree of procrastination increases sequentially, and the 10<sup>th</sup> grade indicates always procrastinating. In terms of procrastination, at which grade do you feel you are located?" According to the results of the survey, the degree of procrastination exhibited by respondents in four different regions was measured, and the average degree of procrastination exhibited by students in these different regions was calculated, as shown in Table 6.

Table 6: Statistics regarding the degree of procrastination exhibited by students in different regions

	Average level of procrastination	Cognitive bias factor $\beta$
Good city (Beijing) group	5.09	<b>0.9162</b>
Medium city (Shijiazhuang) group	4.71	0.9186
Average city (Zhangjiakou) group	3.23	0.9219
Poor city (Guyuan and Zhangbei) group	3.68	0.9194

According to the results of the calculation shown in Table 6, the average degree of procrastination of the interviewed students in the good city (Beijing) group is 5.09, which is the most serious degree of procrastination among the four regions. Simultaneously, the cognitive bias factor of  $\beta = 0.9162$  is also the smallest. The average degree of procrastination exhibited by the interviewed students in the average city (Zhangjiakou) group is 3.23, which is the least serious degree of procrastination among the four regions; the cognitive bias factor of this group is also the largest, i.e.,  $\beta = 0.9219$ .

In the semihyperbolic discounting model, the value of  $\beta$  reflects the degree of short-sightedness of the student. The smaller the value of  $\beta$  is, the more short-sighted the respondent is, that is, the more inconsistent his time preferences are. According to the results of the calculations shown above, students in the good city (Beijing) group are associated with the smallest value of  $\beta$ , indicating that this group exhibits the most serious procrastination. In contrast, students in the average city (Zhangjiakou) group are associated with the largest value of  $\beta$ , and so this group exhibits the least procrastination. That is, students with smaller  $\beta$  or more short-sightedness exhibit more serious procrastination, and students who exhibit more serious procrastination have more inconsistent time preferences; the converse is also true. Therefore, an inevitable connection between students' time-inconsistent preferences and procrastination is evident.

In the questionnaire, the 10th question asked the interviewed students to answer the following question: "Are you satisfied with your grades? (1 point means very dissatisfied, 10 points means perfectly satisfied)".

According to the statistics associated with-students' answers to the 10th question, to analyze the correlation between performance satisfaction and procrastination level, the scores of the answers are first sorted from small to large, and the satisfaction data are divided into ten grades ranging from 1 (the lowest level of satisfaction) to 10 (the highest level of satisfaction) and are expressed in the form  $y_n$ . Subsequently, students' answers to the corresponding question no. 4 (that is, the question concerning the severity level of the student's procrastination) are counted for each level, and the

average value of the procrastination of each satisfaction level group in the table is calculated in the form of  $x_n$ . In accordance with the rules listed above, the statistical results concerning the relationship between performance satisfaction and procrastination level are shown in Table 7.

Table 7: Statistical results of the data corresponding to the relationship between achievement satisfaction and procrastination level

Performance satisfaction level group ( $y_n$ )	1 (the lowest level of satisfaction)	2	3	4	5	6	7	8	9	10 (the highest level of satisfaction)
Average of procrastination levels ( $x_n$ )	9.78	7.45	8.08	5.90	4.91	4.36	3.06	0.84	0.70	1.31

According to the satisfaction data  $y_n$  and mean data  $x_n$  shown in Table 7, a scatter diagram was drawn, and regression fitting was conducted using linear, exponential and polynomial regression fitting. The results are shown in Figure 1, Figure 2, and Figure 3, respectively. It can be seen from these figures that when the polynomial function  $y = 0.0101x^2 - 1.0211x + 9.9251$  is used to fit the above  $y_n$  and  $x_n$ , the  $R^2$  parameter value is the largest (0.9446), and its corresponding correlation coefficient is -0.9719, which indicates that the correlation associated with this function is the best among those associated with the three fitting functions.

A significant negative correlation between students' performance satisfaction and procrastination level can be seen; that is, a student's degree of procrastination is directly related to performance satisfaction; the more serious the student's procrastination, the lower his performance satisfaction; conversely, the less the student procrastinates, the higher his performance satisfaction.

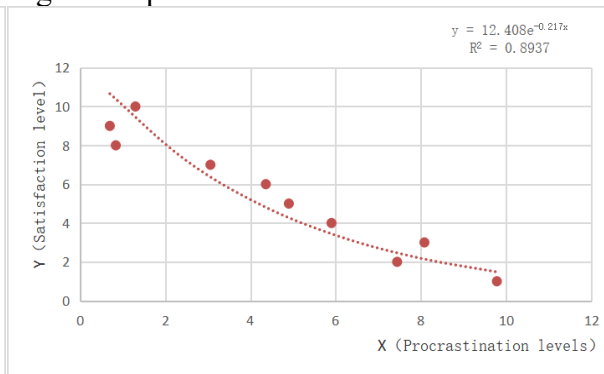
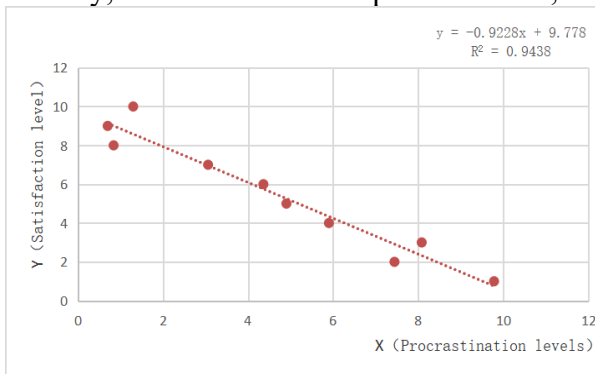


Figure 1: Scatter plot and linear fitting curve

Figure 2: Scatter plot and exponential fitting curve

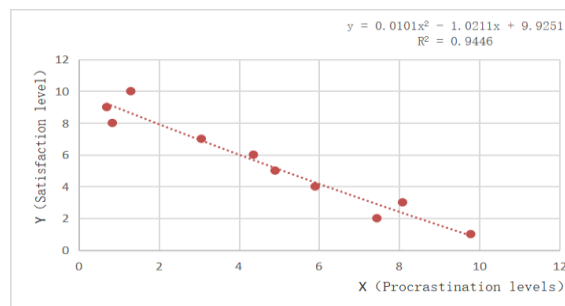


Figure 3: Scatter plot and polynomial fitting curve



## 4. Conclusion

Based on the preceding investigation and analysis, the following conclusions can be drawn. First, the student group also exhibits the characteristics of time-inconsistent preferences; they tend to spend time having fun, and this preference leads them to procrastinate when facing tasks that are associated with immediate harm. Second, among students, time-inconsistent preferences is more strongly correlated with the region in which they are located; students in developed regions exhibit stronger time-inconsistent preferences, and the degree of procrastination among such students is generally more serious and requires more attention. Third, there is a strong relationship between procrastination and time-inconsistent preference. This relationship is shown in the analysis data indicating that when the short-term discount factor value of the interviewed group is smaller (i.e., shortsighted), the degree of procrastination exhibited by the students in this group is more serious. Fourth, the degree of procrastination is one of the determinants of the academic satisfaction of the student group. Procrastination seriously affects academic performance; the more serious a student's procrastination is, the worse that student's academic performance, and a specific polynomial function represents this relationship.

According to the results of other studies, overall, procrastination not only affects students but also all types of people to one degree or another. Therefore, not only students but all people should eliminate the problem of procrastination and develop a good habit of doing things immediately. In addition, taking into account the time-inconsistent preferences reflected by the student groups, to help students overcome their academic procrastination, teachers should try to design a hierarchical incentive mechanism when assigning homework or academic tasks. For example, if a student can finish the homework today, he may only be required to answer 3 questions, but if he does so tomorrow, he may be required to answer 4 questions, while the day after tomorrow, he may be required to answer 5 questions, and so on; that is, it takes less time for students to complete assignments in a timely manner. The mechanism can not only make full use of and guide students' time preferences but also help students develop the good habit of completing homework and reviewing textbooks in time; in this way, students can maximize their learning benefits.

In this paper, by means of a questionnaire survey, the relationships among the time-inconsistent preferences, urban–rural differences, academic procrastination and self-satisfaction of the student group are studied, and corresponding conclusions are obtained. Finally, an incentive mechanism is proposed. However, due to the lack of time and various other reasons, the paper faces the following shortcomings: first, the survey sample is relatively small, and the data are insufficient; second, due to limited conditions, middle school students account for the largest proportion of the interviewed students, and the proportions of primary school students and college students are relatively small.

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