Comparative Study on Grade Point Average Conversion by Dynamic Grade Interval

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ABSTRACT. This paper introduces the basic concept of GPA under the credit system, compares advantages and disadvantages of various calculation methods in practical application by investigating the calculation methods of GPA in universities at home and abroad, and introduces the calculation method of dynamic grade interval, which offers a valuable reference for the calculation methods of GPA in China's universities.

1. Introduction

Credit system originated from the elective system of Berlin University in the 18th century. After continuous development, it has gradually improved and matured in Harvard University. Due to its high adaptability and flexibility, it has been imitated and implemented by most colleges and universities. Based on course selection, credit system is a teaching management system that calculates students' learning volume in credit units and measures whether students' academic achievements meet the standards in terms of "cumulative average credit points" [1]. Therefore, course selection, credit and credit point system are the three elements of credit system.

In recent years, China's Ministry of Education attaches great importance to deepening the reform of the educational and teaching management system. Some systems are proposed in the *Ministry of Education's opinion on accelerating the construction of high-level undergraduate education to improve the ability of talent training in an all-round way* (JG [2018] No. 2). These include "improving the credit system, promoting the improvement of the credit system charge management system, expanding students' learning autonomy and choice, encouraging students to study interdisciplinary and cross-professional, and allowing students to choose their own majors and courses". *The Ministry of Education's opinion on deepening the reform of undergraduate education and teaching and improving the quality of personnel training in an all-round way* (JG [2019] No. 6) puts forward "supporting colleges and universities to further improve the credit system and expand students' learning autonomy and choice right". The development process of credit system teaching management reform and the national policy opinions on credit system teaching management reform fully show the importance of credit system teaching management reform. It is also an important starting point for deepening the reform of educational and teaching system to further clarify the goal of credit system teaching management reform [2].

Although credit system is widely used in China's colleges and universities at present, the results judgment is still mainly based on the percentage system. Students going abroad for exchange or study need to carry out grade point conversion and recognition. In this paper, by analyzing the connotation of GPA, we compare and analyze various conversion algorithms in China's universities, propose dynamic score interval conversion algorithm, and make practice comparison, explore more scientific student learning effect evaluation scheme and conversion scheme, and promote the in-depth development of credit production as teaching management system in higher education. By analyzing the connotation of the average grade point, this paper compares and analyzes various conversion algorithms in universities, puts forward dynamic grade interval conversion algorithm, and makes practice comparison. It also explores a more scientific student learning effect evaluation scheme and conversion scheme, and promotes the in-depth development of credit production as teaching management system in domestic higher education.

2. The Connotation of Gpa

Credit is the unit of calculation for measuring the teaching quantity of the course, the quantitative representation of the depth and difficulty for the course content, and the reflection of the necessary social labor time required for the students to study the course [3].

Grade point is an index to measure the learning quality of the course in the credit system, which has no essential difference from the domestic percentage system and is used to measure the learning quality of the course. Foreign colleges and universities mainly use the four-point system (some colleges and universities use the five-point system, this work only discussed the four-point system) grade point. The core issue of this work is to convert the domestic percentile achievement into the four-point system achievement point.

Credit grade point is the product of credit and grade point (i.e. credit grade point = credit * grade point), which is used to "show the quality of students' learning achievements in each course", thus realizing the quantitative comparison of learning achievements between different courses [4].

Grade Point Average (GPA) is "an important measure to evaluate students' academic performance. It means that the GPA of each course obtained by students multiplied by the credits of the course, and then divided by the total credits after accumulation" [5]. The algorithm is shown in Eq. 1. It is mainly used to evaluate students' cumulative learning effect at a certain stage, and it is also the main embodiment of students' learning ability. As a comprehensive evaluation index of students' learning ability and quality, GPA has become a common performance index of applying for exchange study in foreign universities.

$$GAP = \frac{\sum \text{grade point} * \text{credit}}{\text{total credit}} \quad \text{Eq. 1}$$

3. Comparison of Grade Point Algorithms in Domestic and Foreign Universities

The measuring methods of GPA are different in colleges and universities which implement credit system at home and abroad. Based on research and comparison, the connotation of grade points and the differences at home and abroad can be better understood.

3.1 Common Grade Point Algorithm in Foreign Universities

The implementation standards of credit point system in world-class universities are not the same. For example, Harvard University in the United States generally adopts a grade 11 system, the highest grade is A, and the highest grade point is 4.0. Although Nanyang Technology University in Singapore also implements 11 system, the highest grade and highest grade point are different from American universities. Nanyang Technology University sets the highest grade as A+, but both A+ and A corresponding highest grade point are 5.0 [6]. The credit system implemented by domestic universities mainly originates from the American model. This work mainly took American universities as an example. The commonly used grade point conversion method in American universities is based on the rating system, and the comparison relationship is relatively simple, as shown in Table 1. In American colleges and universities, it can be seen that the scores obtained by students through the grading system have a one-to-one correspondence with the grade points, which is only the result of achievement quantification. On this basis, the GPA calculated do not have errors. Moreover, the grading system adopted by American colleges and universities has a certain proportion of distribution, which ensures that a certain proportion of students in each grade or grade point segment get a certain proportion.

Table 1 Grade Point Conversion Form in American Colleges and Universities

Grades	Grade Points	Percentage of Marks
A	4.000	Greater than 93%
A-	3.670	87-89.9%
B+	3.330	84-86.9%
B	3.000	80-83.9%
B-	2.670	77-79.9%
C+	2.330	74-76.9%
C	2.000	70-73.9%
C-	1.670	67_69.9%
D+	1.330	65-66.9%
D	1.000	62-64.9%
D-	0.670	59-61.9%
F	0.000	<59%(Fail)

3.2 Common Grade Point Algorithm in Domestic Universities

The centesimal system is widely used in domestic colleges and universities. In essence, which scoring system is adopted has nothing to do with the credit system. The centesimal system score is equivalent to the grade point in the credit system, which can also reflect the quality of students' learning. However, due to the demand of overseas exchange or study abroad, the same standard is needed to measure students' learning effect, which in turn leads to the need for the conversion of percentile grades to grade point arises. According to the research, there are mainly the following algorithms in China:

Table 2 Grade Point Conversion Algorithm 1 in Domestic Colleges and Universities

Centesimal system	90-100	80-89	70-79	60-69	59 and below
Graded system	Excellent	Good	Centre	Pass	Fail
GPA	4.0	3.5	2.5	1.5	0

Table 3 Grade Point Conversion Algorithm 2 in Domestic Colleges and Universities

Centesimal system	90-100	85-89	82-84	78-81	75-77	71-74	66-70	62-65	60-61	Pass	≤59
Graded system	A	A-	B+	B	B-	C+	C	C-	D	D-	F
GPA	4.0	3.7	3.3	3.0	2.7	2.3	2.0	1.7	1.3	1.0	0

Table 4 Grade Point Conversion Algorithm 3 in Domestic Colleges and Universities

Centesimal system	95-100	90-95	85-90	80-85	75-80	70-75	67-70	65-67	62-65	60-62	<60
Graded system	A+	A	A-	B+	B	B-	C+	C	C-	D	F
GPA	4.3	4.0	3.7	3.3	3.0	2.7	2.3	2.0	1.7	1.0	0

Course GPA = $4-3*(100-X)2/1600$ $(60 \leqslant X \leqslant 100)$ Eq. 2

Algorithm 1 is the earliest and most widely used grade point conversion method in China. It was first used by Peking University by converting the percentage system into corresponding grade points, and then it was widely used by domestic colleges and universities. So far, many colleges and universities still use this algorithm. Algorithm 1 is difficult to distinguish the students' differences in the same grade segment due to the large division interval, so that the "error" is large. Domestic colleges and universities continue to improve in the use process. By dividing the centesimal system into more sections and reducing the score section, the conversion will be more "detailed". Based on the characteristics of the school's performance distribution, the non-uniform interval is divided to increase the rationality of grade point conversion. For example, the algorithm 2 currently being used by Fudan University and the algorithm 3 currently being used by Shanghai Jiaotong University come from the adjustment of algorithm 1.

The advantages of the above three algorithms are simple and clear, easy to operate, and the calculation accuracy is also constantly improved. However, there will be "unfairness" in the interval conversion algorithm. For example, although there is only one difference between 84 and 85 in algorithm 2, there is a difference of 0.4 after grade point conversion. Suppose that a student's four-year academic performance is 84 points, and another student's four-year academic performance is 85 points. The learning quality and ability of the two students should be similar. However, according to the calculation method of algorithm 2, the difference is very large. The interval conversion algorithm makes the students just on the grade point conversion line "cheap", while the students just under the grade point conversion line "suffer losses". Algorithm 4 is the conversion method now used by Peking University, which can realize linear conversion from percentile score to grade point. It basically solves the disadvantages of above interval conversion, but slightly increases the calculation workload.

3.3 Algorithm Comparison At Home and Abroad

The following differences can be obtained by comparing the above algorithms at home and abroad.

First. The foreign grading system itself corresponds to the quantitative grade point, and there is no error when the grade point is used. However, the domestic colleges and universities generally use the centesimal scoring system (a small number of courses use the five-level scoring system or two-level scoring system), which will inevitably lead to the production of errors by converting the interval conversion algorithm into grade point.

Second. The linear transformation algorithm used in algorithm 4 can effectively solve the error caused by the transformation interval, but it loses the relationship with the hierarchical comparison and limits the application

occasions.

Third. Domestic grade point conversion algorithm can not solve the problem of non normal distribution. In the grading process of foreign colleges and universities, the scores are graded based on a certain proportion of students' number. Domestic colleges and universities mainly use examination papers, and the results are accumulated from the scores of various questions on the paper. It often appears that the test paper is too difficult to lead to less or even missing students in the high section of the course, or the test paper is too simple to lead to more students in the high section of the course, unable to control the normal distribution of the course results. So it can not control the normal distribution of the course results.

Fourth. In some domestic universities or courses with strict requirements, the students' achievement in the centesimal system is low. After the grade point conversion, the grade point can not reasonably evaluate the students' actual level. For example, A studied in a famous university with strict teaching requirements in China, with a GPA of 3.2. B studied in a university with relatively loose teaching requirements in China, with a GPA of 3.8. A and B apply for the qualification to study abroad in a foreign university at the same time. A may miss the opportunity because of the inferior performance. Secondly, different classes in the same course have different evaluation standards and academic requirements. Using a unified score conversion algorithm will also lead to the unfairness for students' grade points.

4. Building Dynamic Performance Conversion Interval Algorithm

The key to improve the credit system teaching management in domestic colleges and universities is to make the calculation method of the average credit score point scientific and reasonable, and to evaluate the quality of students' learning truthfully. It can not only reflect the difference of students' learning level and avoid the phenomenon of "losing", but also promote the continuous improvement of teaching management system in colleges and universities. Aiming at the comparative study of the above algorithms at home and abroad, the author proposed a dynamic score conversion interval algorithm. The key point is to solve the problem of fairness caused by the low score of the centesimal system and the lack of high grade points, while taking into account the characteristics of practical operability and ease of use. The algorithm is shown in Table 5:

Table 5 Dynamic Performance Conversion Interval Algorithm

Grading system	Course results		Grade	Course GPA
Centesimal system (Grading interval)	Pass	Top 20%	A	4.0
		20.1%-35%	B+	3.7
		35.1%-50%	B	3.3
		50.1%-60%	B-	3.0
		60.1%--70%	C+	2.7
		70.1%-80%	C	2.3
		80.1%-90%	C-	2.0
		After 10%	D	1.7
	Fail		F	0.0

Taking all students' scores in the same teaching class as the observation object, this algorithm divides different grade point conversion intervals based on the scores distribution. This conversion method is the only conversion algorithm for the corresponding teaching class, thus avoiding the problem that the inherent conversion interval cannot take into account the inconsistent scoring standards. According to Table 5, it can be seen that the algorithm divides the two categories of pass and fail in the centesimal system score, and the highest score from 60 to this teaching class is pass. This interval is divided into eight score intervals according to the proportion, forming the grade point conversion interval, and the student's score is converted into grade points based on the conversion interval of the class. For example, the highest score of a teaching class is 90 points, and the lowest score is 55 points. According to this algorithm, students with 60-90 points can obtain grade points. The 30 areas between 60-90 points are divided into eight areas to develop conversion areas. Students with scores in the first 20% of the scores (84-90 points) are classified as A, which corresponds to 4.0 of course grade points. Students with scores in the first 20.1% - 35% of the scores (79.5-84 points) are classified as B+, corresponding to course grade point 3.7, etc.

The algorithm effectively solves the problem of non normal distribution and the difference of teachers' grading standards, and retains the corresponding relationship with the grading system. By using a large number of original scores in teaching classes for verification, the grade points are basically improved compared with algorithm 2, and the results of six teaching classes using two grade point algorithms are shown in Table 6.

Table 6 Comparison Results Between Old and New in Grade Point Conversion Algorithms

Grade point	Course 1		Course 2		Course 3		Course 4		Course 5		Course 6	
	Old	New	Old	New	Old	New	Old	New	Old	New	Old	New
4.0	11	11	13	13	19	13	16	19	1	5	15	37
3.7	8	8	8	8	16	20	9	10	4	5	25	23
3.3	4	5	9	17	6	14	5	8	3	3	18	4
3.0	1	3	10	8	9	11	7	1	4	3	6	2
2.7	3	6	6	6	13	10	1	3	3	5	0	0
2.3	6	3	9	9	7	11	3	0	3	5	2	1
2.0	9	8	8	2	11	4	0	0	8	3	1	0
1.7	3	4	5	6	5	12	0	0	6	9	1	1
1.3	3	0	1	0	9	0	0	0	6	0	0	0

* The old algorithm uses algorithm 2, and the new algorithm uses dynamic result conversion interval algorithm

Dynamic score conversion interval algorithm has been tried out in South China University of Technology for more than four years. It can calculate student's score more scientifically and reasonably, which is highly praised by teachers and students, and also widely recognized by foreign universities.

5. Conclusion and Outlook

As an important evaluation index of students' learning ability and quality, GPA is the main component of the credit system. With the continuous and in-depth implementation of the credit system, it is not only required in the application process of international exchange, but also more widely used scenarios, such as student award, recommendation for graduate students, degree award, etc. Therefore, it is necessary to improve the calculation method of the average credit score point under the credit system, and judge students' learning effect scientifically and reasonably. It is of great significance to promote teachers to improve teaching quality, improve teaching management of relevant departments, carry out teaching reform and improve the quality of talent training.

Acknowledgement

References

[1] Shi Guyang, Credit System and Elimination System. Higher Education Exploration, no.1, pp. 55-58, 1997.

[2] Ding Jialing, Some Thoughts on Continuously Promoting the Reform of Credit System Teaching Management. Education Teaching Forum, no.11, pp. 12-14, 2020.

[3] Li Guoling, Discussion on the Management of Student Status with Credit and Achievement System. Journal of North China Institute of Water Resources and Electric Power (Social Science Edition), no.2, pp. 101-103, 2002.

[4] Pedagogy Dictionary (Second Edition). Haikou: Haikou Publishing House, pp. 325, 1997.

[5] Li Yajun, Zheng Hongxing, Zou Xiaolan. Application Analysis on Using Standard Score Method to Measure Student Grade Points. Journal of Higher Education, no.16, pp. 183-185, 2019.

[6] Lv Xiaoqin, Construction Identification and Basic Elements of the Credit Point Evaluation System. Higher Education Exploration, no.11, pp. 27-32, 2019.