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Relationship Between China's College Entrance Examination and High School Teaching-Learning

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To investigate the relationship between the College Entrance Examination (CEE) exams and high school teaching-learning, we conducted a questionnaire survey and collected 2439 valid questionnaires with 16000 teachers involved. This paper discusses the topic with data gathered from the survey, and statistics on CEE examinations over the past few years. The following three questions will be addressed in detail:

1. As a talent selection test for colleges, can the CEE exams single out the elite students in high school?
2. Should the testing objectives of the CEE exams match the teaching objectives in high school so as to have a positive backwash effect on high school teaching and learning?
3. How do teachers assess the CEE exams from the angles of test structure, the functions of individual item types, reforms on test difficulties, and its actual checking effects?

INTRODUCTION

The current college admission rate in China is lower than seven percent so higher education is primarily an elite education. The College Entrance Examination (CEE) is no longer a single selective test whose sole function is to select qualified students for colleges. Its impact has grown beyond the sphere of the educational system. The test itself has become a socio-cultural phenomenon and an integral part of social life. It is now playing an important role in directing the flow of human resources towards forming a sound and stable social structure. The test-based selection of talents should, on the one hand, follow such laws of the market economy as value, competition, and supply and demand. But on the other hand, embody the principles of social organizational structures such as fairness, equity, and order. The study of the relationship between examinations and teaching and learning should firstly take into account China's national conditions. These are characterized as having a huge population, a backward economy, an unreasonable industrial structure, a marked regional differences and a high employment pressure.

These features and others have resulted in an improper exaggeration and expansion of the role of education in China, and the examination competition is probably far more fierce than any other country in the world.

I. Evaluation on the Selective Function of the CEE Examination

During the survey, we gathered all the teachers' assessments on whether the students' performances in the CEE exam tally with their usual performances, which are presented in Table 1.

Table 1. Teachers' assessments on the matchability between students' performances in CEE and their usual performances

Assessment	Match	Basically match	Do not quite match	Do not match
Mathematics	7.87%	89.18%	2.95%	0.00%

Statistics in Table 1 show that the majority of teachers hold that the CEE are capable of making fair selections. About 97% of them think that the students' performances in the CEE exam matches well their usual performances. Only about 3% of the teachers hold negative opinions.

II. Correlational Study of Students' CEE Scores and Their School Scores

The students involved in the study were ranked according to their scores in school records and on the CEE exam. The first 20% were labeled as Grade I, the second 20% Grade II, and so on, with the last 20% labeled as Grade V. Statistical results are presented in Table 2.

A simple mean of the matchabilities is 77.60%. Students who were grouped into Grade I and Grade II based on their school scores had higher matchability between the CEE and school scores than students in other grades. That means CEE can well single out good students. Grade III and Grade IV students in terms of their school scores had more instances of abnormal performances on their CEE exam. High school experiences have also shown that, in a class, students whose school scores fall into the range of 40% to 60% on the grading continuum have very inconsistent performances on tests. This group of students center around the peak value on the normal distribution curve. For this

group, the number of students in each score segment far exceeds those at the far two ends of the bell curve. Therefore, the differentiation of this group of students on the CEE is affected and there are more instances where their CEE scores fail to reflect their usual performance. Students in Grade V, however, had CEE scores that match well their school ones, which suggests that poor students normally get low scores on the CEE exam.

Table 2. A comparison between students' school scores (in mathematics) and their CEE scores

Percentage		CEE Scores					
		Grade I	Grade II	Grade III	Grade IV	Grade V	Matchability
School Scores	Grade I	53.96%	25.92%	12.16%	7.40%	0.52%	79.89%
	Grade II	25.14%	27.48%	25.14%	13.45%	8.77%	77.77%
	Grade III	16.36%	26.66%	20.60%	26.06%	10.30%	73.33%
	Grade IV	5.32%	14.20%	27.81%	23.07%	29.58%	80.47%
	Grade V	2.46%	6.17%	14.81%	27.77%	48.76%	76.54%
	Match-ability	79.11%	80.07%	73.56%	76.91%	78.35%	77.60%

III. Teachers' Evaluation of the CEE

Table 3. Viewpoints on the CEE

No.	Points of view
1	It is difficult for normally poor students to do well on the CEE.
2	The CEE is fair to every student.
3	The students selected by means of the CEE do not have high scores but poor abilities.
	The abolition of the CEE would not bring about a reduction of students' burden.
4	The CEE is conducive to stimulating students' interest in study.
5	The competitive pressure as a byproduct of the CEE has a more positive effect.
6	The abolition of the CEE would lower teaching and learning quality in high school.
7	The CEE has not brought to high school seniors any excessively high pressure or burden.
8	The CEE plays a positive role in the teachers' self-development.
9	The CEE plays a positive role in the teachers' self-development.

Table 4. Teachers' response to the viewpoints in Table 3.

No.	1	2	3	4	5	6	7	8	9
Agree	75.7%	31.4%	13.2%	27.2%	49.3%	52.2%	54.5%	6.7%	26.7%
Basically agree	20.1%	51.5%	42.1%	14.7%	40.0%	36.5%	25.3%	16.8%	30.8%
Quite disagree	3.4%	12.9%	28.7%	18.1%	7.9%	7.3%	13.7%	37.5%	23.7%
Disagree	.9%	4.3%	15.9%	40.0%	2.9%	4.0%	6.5%	39.0%	18.8%

The above table shows that, by and large, teachers are in favor of the CEE while disapproving some aspects of the examination.

Firstly, an absolute majority of teachers (90%) think the CEE has more positive effects than negative effects. In other words, the CEE is indispensable in that its existence contributes to the fulfillment of teaching objectives. It also stimulates the students' interest in learning. If the CEE were to be abolished, most teachers hold, the quality of teaching and learning in their high schools would drop.

Secondly, 83% of the teachers interviewed said that the CEE, as an instrument for talent selection, is fair to every student. As high as 96% of the teachers said it was difficult for poor students to excel in the CEE. That is to say, the CEE is able to single out good students according to these teachers. This also matches related statistics above.

Thirdly, teachers' complaints against the CEE focus on the students' burden. About 76.5% of the teachers complained that the CEE imposes excessive pressure and burden on students. 58.1% of them held that the abolition of the CEE would reduce students' burden. Further interviews with some teachers revealed that in view of the fierce competition for the CEE, students who strive for good CEE scores often experience excessive learning burden. Most of the time, students facing the CEE challenge attach a sole importance to intellectual development while neglecting physical exercise, which results in body deterioration. They also pay more attention to personal self-development rather than ideological and moral refinements with their corresponding team work. The focus on the range of knowledge to be tested on the CEE also affects the expansion of the students' breadth of knowledge.

In addition, in order to help students cope with the CEE, teachers usually make them do a large number of repetitive exercises. These harm the cultivation of students' creativity. Meanwhile, teachers themselves refrain from trying out new possible teaching methods for fear that their experiments might cause the students' CEE to drop. This explains why there were only 57.5% of the teachers who said that "CEE plays a positive role in teachers' self-development".

The much-debated issue that "high score winners have low abilities" is also a controversial one among the teachers. More than half of them (55.3%) said that they rejected

the idea that a remarkable numbers of students selected by means of the CEE had "high scores but low abilities". It is also to be noted that 44.7% of the teachers held the opposite views. Here, the question of validity in ability evaluations is raised. As for the CEE mathematics test, although the test papers normally have ideal structural validity, not enough statistical analysis has been done concerning their forecast validity. As opinions from some college teachers and the results of some of our tests show, some new college students from certain regions did quite well on the CEE mathematics test. But they ran into various difficulties in college mathematics learning. Although the students' scores on college tests can not fully reflect their competence, the difficulties they had encountered do suggest that the CEE-oriented intensified training they had received before CEE produced the training effects on their studying. Therefore, it is desirable to further study the validity of the CEE mathematics test in terms of a competent evaluation.

IV. A contrastive analysis of high School Teaching Objectives and the CEE Testing Objectives

Table 5. Mathematics teachers' comments on teaching objectives and testing effects

Mathematics	Logical thinking ability	Calculation ability	Spatial imagining ability	Analytical ability	Application ability	Mathematical thinking	Else
Teaching objectives	1.550	0.960	0.230	1.270	0.490	1.430	0.020
Testing effect	1.470	1.300	0.150	1.680	0.290	1.020	0.000

In the teachers' viewpoints, the abilities that mathematics teaching should aim to foster in students, when listed in an order of importance, are logical thinking, mathematical thinking, analytical thinking, calculation, and application abilities. The abilities that CEE mathematics examinations try to test, however, are analytical thinking, logical thinking, calculation, and mathematical thinking. We can see that the CEE mathematics test can satisfactorily check calculation, analytical thinking, and logical thinking abilities, but does a rather poor job in the checking of mathematical thinking with its corresponding application abilities.

(1) A major issue with ability testing is how to properly deal with the relationship between calculation and thinking. Teachers surveyed said that the logical thinking ability demanded in the CEE test basically conformed with the teaching requirements, while the calculation ability was higher than required in the

teaching syllabus. The nature of mathematics determines the weight of calculation in solving mathematical questions. However, logical thinking and spatial imagining abilities should be tested together with the calculation ability since mathematics is an integrated subject. In recent years, it has been the constant endeavor for the CEE mathematics test designers to ensure an in-depth ability check, while trying to control the amount of calculation required on a fundamental level. The underlying guiding principle is having more focus on "thinking" than on "calculation". For the past few years, the increasing demand on algebraic reasoning in tests is an embodiment of that principle. However, the 1996 and 1997 tests failed to meet ideal testing goals. The test takers' scores in algebraic reasoning averaged lower than 0.2. Therefore, further study is desired on the relationship between calculation, thinking, and test difficulties as well as the characteristics of students' thinking along with their thinking capacity.

(2) Feedback on application, open, and exploration questions in the CEE mathematics tests.

As for application questions, starting from 1993, CEE mathematics tests have gradually increased efforts on checking students' application ability. But there have been no anxiety for quick results. At the initial stage, such testing highlights were integrated in test items such as multiple choices, and blank filling. The purpose was to attract teachers' attention to application problems, and to make both theoretical and practical preparations for the initiation of application questions. Starting from 1995, application questions have been incorporated into essay questions. Although students' scoring rates came out quite low in two successive years, the test items have won positive comments and support from high school teachers.

Three quarters of the teachers said that application, open, and exploration questions have had positive effects, with the exploration questions winning the most applause. Detailed statistics are put in Table 6.

Table 6. Comments on the effects of application, open, and exploration questions

Test types	Whether or not they are conducive to students differentiation		Whether or not conducive to improving mathematics teaching	
	Yes	No	Yes	No
Application	72.64%	27.36%	72.05%	27.95%
Open	77.32%	22.68%	70.79%	29.21%
Exploration	86.35%	13.65%	82.59%	1.41%

Statistics shows that 73% of mathematics teachers agreed that application questions contribute to the discrimination of students in terms of competence, which reflects the teachers' understanding of and support of the adoption of application questions. Table 5 shows that there is a certain distance between the testing of application ability and the teaching requirements. The average scoring rates for students of science in the 1995 and 1996 application questions are 0.23 and 0.20 respectively. For students of arts, the figures were only 0.17 and 0.08 respectively. This suggests that students' competence fell far short of the testing requirements. Thus, more research should be done with regard to these characteristics. The students' greatest competence needs to be found lay a foundation for a scientific design of test items. It is hoped that with these efforts, the difficulty of test items will match students' problem-solving capacity. Students will then be able to know how to approach a problem in tests, so that students' application ability can be accurately evaluated by means of the test items.

V. Item Types and Test Paper Structure

It is stipulated in the book, Specifications on Mathematics Tests, that the proportion of multiple-choice, blank-filling, and essay questions (including questions for proof and calculation questions) are 45%, 10%, and 45%. The structure has been thus decided upon after considerations has been made on multiple factors such as testing purposes, characteristics of target subjects, paper-rating labor, and control on rating errors. The merit with this type of structure lies in the fact that objective and subjective test items are integrated, which benefits the checking of students' command of basic knowledge, basic skills, and certain high-level mathematical abilities. During this survey, 17.9% teachers thought multiple-choice questions were more than the students could cope with in the time given. The teachers' written comments showed that some of them thought the quantity of objective test items was inappropriately large. Since objective test items are subject to training effects and favor problem-solving speed, they are likely to direct students' attention to memory-type test items and stress problem solving speed, which to a certain degree affects the objective items giving play to their objectivity. Since the existence of objective items often increases the quantity of the total test items, students usually pay more attention to memorizing related knowledge and methods which are needed for solving the problems so that they can speed up the problem-solving process. Therefore, the large quantity in test items often results in the tendency that test takers deal with the tests with speed and familiarity. In fact, tests are divided into power tests and speed tests. The objective of the CEE examination is, on the one hand, to increase the coverage of the tests by increasing the amount of the objective test items. Also it checks

the test takers' problem-solving speed. On the other hand, the CEE examination is intended to check the test takers' mastery of knowledge along with various high-level competence. However, the existence of many difficulties in examination management makes it difficult to separate power tests from speed tests. Thus, test takers demonstrate their competence mainly through their speed and accuracy in problem-solving. Pure paper-and-pencil tests may lead to the students' emphasis on textbook knowledge and negligence of practice and reality. This in turn leads to the lowering of their operational ability along with ability in solving practical questions.

Table 7. Structure of 1983-1994 old test papers.

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Multiple-choice questions	12.5	12.5	12.5	25	20	37.2	30	37.5	37.5	45	45	41.6
Blanking-filling questions	15	15	12.5	20	23.3	16.7	20	12.5	12.5	12.5	15	16.7
Questions for solutions	72.5	72.5	75	55	56.7	45.8	50	50	50	42.5	40	41.7

Table 8. Structure of 1991-1997 new test papers.

	1991	1992	1993	1994	1995	1996	1997
Multiple-choice questions	36	45.3	45.3	43.3	43.3	43.3	43.3
Blank-filling questions	16	16	16	13.2	13.2	13.2	13.2
Questions for solutions	48	38.7	38.7	43.5	43.5	43.5	43.5

VI. TEST DIFFICULTY

Analysis of test difficulty should be made from two perspectives. One is to what degree the test items can discriminate the test takers. The other is high school teachers' comments on them. Table 2 reveals that there is a higher rate with Grade II and Grade III students, particularly Grade III students. The CEE results fail to distinguish between them. Experiences tell us that tests with higher difficulties can discriminate better students. Here are two examples to illustrate the point. In China the CEE is classified into two categories: science category and liberal art category. There are common items in the mathematics test papers for the two categories. When the same item is set to students of both science and liberal arts, the scoring rate with students of arts is 10–20 percentage

points lower than that with students of science. But the discrimination rate with students of liberal arts is higher. In recent years, the overall test difficulty for students of liberal arts has been lower than that with students of science. The standard deviation which reflects the students' diffusion has been larger with students of arts than with students of science. Therefore, viewed from the angle of student discrimination and the current college admission rate of about 40%, full range discrimination (discrimination within 0–150 points) with the first 50 percent of the students will produce a more accurate discrimination. For students of Grade II and Grade III in particular, their test results will be closer to their competence and thereby benefit the admission of qualified students by colleges. This, however, is impractical to high school teaching. Hence, the difficulty of the CEE mathematics test has been controlled within 0.55–0.59. This survey revealed that about 50% of the teachers involved thought that the difficulty of the algebra and plane analytical geometry test items was appropriate while 75% of them thought that the difficulty of the test items for cubic geometry was appropriate. Less than 5% of the teachers thought all the test items were relatively too easy. Therefore, the CEE examination can only keep a hard balance between the endeavor to help colleges with talent selection and the endeavor to produce a positive backwash effect on high school teaching and learning.

Table 9. Difficulties of the 1986–1994 old test papers

	1986	1987	1988	1989	1990	1991	1992	1993	1994
Difficulty	.61	.52	.72	.53	.51	.57	.66	.59	.55

Table 10. Difficulties of the 1991–1994 new test papers

	1991	1992	1993	1994	1995	1996	1997
Difficulty	.59	.65	.58	.55	.59	.55	.59

CONCLUSION

(I) The CEE examination gives good play to its function of talent selection in that it has indeed selected students with excellent school records, and students with poor school records can hardly get good scores on it. The CEE exam provides every student with an opportunity for fair competition. It is conducive for realizing high school teaching objectives, stimulating students' interest in learning, and improving high school teaching.

(II) It is true that the fierce competition for the CEE exam has exerted certain

pressures and burdens on students. However, the survival competition for human beings in general is a hard fact in itself. Examinations are only one form of competition in human society.

(III) In recent years, the test items in the CEE has well matched high school teaching objectives and suited the teaching reality in high schools. The content proportion of the test papers, the difficulties of individual sections, and the proportion of different test types are basically appropriate. The reform and innovation measures for the CEE exam have played their backwash effects on high school teaching. They have promoted the reform of high school teaching and learning, and also gained teachers' understanding, affirmation and support.

(IV) Suggestions: It is desirable to do the following four things to an appropriate degree. One is to intensify the checking of the mathematical thinking methods. Second is to increase the number of subjective test items. Third is to increase the number of application test items. Fourth is to lessen the excessive demand on the total quantity of test items along with their problem-solving speed.

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