
THE EFFECT OF A GOVERNMENT-SPONSORED E-LEARNING PROGRAM ON THE ACADEMIC ACHIEVEMENT OF HIGH SCHOOL STUDENTS: EVIDENCE FROM KOREA

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Abstract

This study uses the first and the second round surveys of Korean Education and Employment Panel to examine the effect of the EBS e-learning program, a government-sponsored e-learning service for high school students for their preparation of College Scholastic Aptitude Test (CSAT), on the CSAT score. The empirical results show evidence that the EBS e-learning program has a positive effect on the students' performance in the CSAT. While the positive effect of the EBS program is consistent in all areas of the CSAT, the size of the effect is largest in math. In addition, the conditional quantile regression result suggests a differential effect among students, in which the EBS e-learning program benefits less-able students more than able students. This finding implies that the EBS program can play an important role in reducing the educational gap among students and alleviating parents' financial burden of providing private tutoring for their children.

Keywords: E-learning, EBS College Scholastic Aptitude Test Program, Students' Achievement, Korean Education and Employment Panel, Conditional Quantile Regression

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1. Introduction

This study uses the result of the college scholastic aptitude test (CSAT) to examine the effect of a government-sponsored e-learning program on high school students' academic achievement in a Korean context. The Korean government introduced an e-learning program in 2004, whose main purpose is to reduce the growing demand for private education and rebuild the public school system. The e-learning classes is provided by EBS (educational broadcasting system), a government-sponsored broadcasting provider, and is aired through the EBS channel or can be reviewed through internet. The subjects of the EBS e-learning programs covers almost all subjects taught in regular high schools. That is, the EBS e-learning programs offer supplementary teaching to high school students so that they can review subjects on line in which they need an additional assistance from professional teachers. Recently, the Korean ministry of education announced that they will refer heavily to the contents of the EBS e-learning programs when making questions in the official college scholastic aptitude test (CSAT), whose result is the most important element for college entrance in Korea. These days, the EBS e-learning program is becoming the most popular supplementary learning method that high school students take to prepare for the CSAT. A recent study by Chae (2011) showed that 81.9 percent of general high school students use an EBS e-learning program, an evidence to reflect the important role of the EBS program in students' school achievement.

The EBS e-learning program in Korea started with a unique motive. Unlike e-learning programs in other countries where an e-learning is provided to students who are unable to receive formal education due to regional isolation or limitation of health, the primary purpose of the EBS e-learning program in Korea was to curb the growing expenditure on private education. Since the EBS e-learning programs are aired through public channel or provided through internet, there is basically little expenditure incurred by households, except for textbooks. It was presumed that this kind of cheap e-learning service would substitute the relatively expensive private supplementary education, which was prevailing among students, reducing the overall expenditure on private education. However, there is no consensus reached yet among scholars as to whether the EBS e-learning program achieved its presumed goal of reducing the overall expenditure on private education.

The goal of this study is to investigate how the EBS e-learning program affects high school students' academic achievement by examining the scores of CSAT. Although it is important to examine whether the EBS program indeed reduces private education expenditure and whether it eliminates the regional gap in educational outcomes, a further discussion on these issues will call for a rigorous analysis on the impact on the students' scholastic achievement of the EBS program. Despite of the imperative need for such analysis, relatively little attention has been taken to the effectiveness of the EBS program for improving students' academic performance among scholars. Furthermore, if any, the existing studies look at only the 'average' effect of the EBS e-learning program, ignoring the relative effects among students with different ability. Identifying such relative effects is important for practitioners and scholars because the results can provide valuable policy implications for reducing educational gap among different students and regions. Specifically, if the EBS e-learning program provides more benefits for less-able students than for abler students, it can contribute successfully to reducing education gap among heterogeneous students. This study attempts to add an extra contribution to the existing literature on e-learning by examining whether such relative effects indeed exist.

2. Literature

This study contributes to the existing literature on the effects of e-learning on students' performance by examine the impact of the EBS e-learning program on students' academic achievement, to which relatively little attention has been paid. Although there is a sheer volume of research accumulated on the EBS e-learning program, most of the previous research focused on exploring the impact on reducing private education expenditure, the primary goal of the EBS program. However, even the previous studies on the impact on students' performance have limitations in several aspects, such as relatively small samples, lack of representativeness of the sample, and less-objective measure of students' performance. This study will overcome these shortcomings of the previous research by using large samples that represent the entire population well and objective performance measure of CSAT.

The studies of the effect of the EBS e-learning program on the reduction of private education expenditure diverge in the results. The results vary by the data used and the method employed. For example, the survey by Korean Ministry of Education, Science and Technology (KMEST, 2005) reported that students who used an EBS program spent less expenditure on private education than those who did not. The same positive impact on the reduction of private education expenditure was observed by the study of Lee et al. (2005). However, in surveys which asked each

respondent a subjective opinion on whether the EBS program is expected to reduce private education expenditure, many more individuals expressed a negative view. In addition, the view on the impact of the EBS program on private education expenditure differs between teachers, students, and parents (Jeon et al., 2006; Sohn, 2004; Lee et al., 2004). A negative or insignificant impact of the EBS program for cutting down the private education expenditure was also witnessed in more rigorous studies (Chae, 2007; Park, 2008) which controlled for various confounding factors that may the outcome variable simultaneously.

There are relatively fewer studies that examined the impact of the EBS e-learning program on students' performance. In the study by Lee et al. (2004), who surveyed high school students their individual perceptions of how helpful the EBS e-learning program is for their study, many more students answered negatively on this question. In particular, this negative perception was found stronger in Kangnam in Seoul, which is the wealthiest region in Korea, than other regions, and in high income households than in lower income households. Furthermore, students who performed better in school were more likely to show a native view on the role of the EBS program for improving their academic performance. However, different finding was suggested in the study by Chae (2007), who used the result of CSAT, a more objective measure of students' performance, and attempted to consider various confounding factors in the model to better identify the impact of the EBS program on students' academic achievement. His study provided positive evidence of the EBS program, suggesting that students who took the EBS e-learning program as the primary means of supplementary education tended to achieve higher scores in the CSAT, particularly in the areas of Korean language, math, and foreign language. Shin and Chang (2011) estimated the impact of the EBS program in the same manner. They found a result that there was no statistically significant difference between students taking an EBS e-learning class and those receiving other modes of private education, and asserted that the EBS program may not be significantly effective to suppress the growing expenditure on private education.

However, previous studies on the EBS e-learning program have some limitations. One of the criticisms raised on the existing studies is about the use of a less-objective measure of students' performance. For example, the studies by Lee et al. (2004) and Jung et al. (2008) use individuals' subjective perception on the expected impact of the EBS program. The data gathered from the subjective response may over- or underestimate the true effect of the EBS program. Another shortcoming of the previous studies is the relatively small sample size. Many of the previous studies use only a few hundreds of students or less. The small sample size may make it difficult to draw a meaningful inference on a statistical standpoint. In addition, previous studies tend to use samples from particular schools or regions. This restriction on the sample may weaken the representativeness of the sample and can make it difficult to generalize the results to the entire population, given that educational environment varies a lot by regions in Korea. Lastly, most previous studies are based on the results of simple statistics. This kind of simple analysis ignores the potential confounding effects that can be included in the estimate of a causal effect. The outcome variable, students' performance, can be influenced not only by the EBS program but also strongly by household and community characteristics simultaneously. Ignoring these confounding factors in the analysis may lead to a bias in the estimate of a policy, the EBS program. Even in the studies (for example, Chae (2007) and Shin and Chang (2011)), which consider possible confounding effects in the model, some important factors such as school (quality) characteristics are not still in consideration. Furthermore, the previous studies on the EBS program attempted to look at the 'average' effect on students' performance. However, it is of political importance to investigate 'relative' effects among students with heterogeneous ability and regions with dissimilar education environment. The result on the relative effects may shed light on finding target groups or regions in need, on which the program should give more weight to produce better outcomes.

This study attempts to make differential contributions to the existing literature by overcoming the above-mentioned shortcomings of the previous studies on the EBS program in the following ways. First, we use large-scale data obtained from a particular survey which is conducted on representative samples of students in Korea. This ample sample will enable us to better identify, on a statistical aspect, the impact of the EBS program. Since the data to be used in this study comes from representative samples of students, it may escape from the criticism on the lack of representativeness of samples, from which previous studies often suffer. In addition, we will use a more objective measure of students' academic performance. More specifically, this study will examine the test scores of the CSAT. Since this test is offered by the KMEST and taken by senior high school students who want to enter a college, the test scores possess the objectivity as a performance measure very well. Another contribution of this study to the existing literature is a consideration of various confounding factors that may affect the outcome variable, the test score of the CSAT, as well. In particular, we try to control for school quality in the identification of the impact of the EBS program. To the extent that school characteristics are closely associated with the students' academic outcomes and that students' choice of the EBS program depends on school attributes, ignoring such effects of school characteristics may corrupt the estimate of the impact of the EBS program in the regression analysis. We will take

these school factors into consideration by adding various school attributes in the model when we run a regression to unveil the EBS program effect. Lastly, and more importantly, unlike previous studies which estimated only the average effect of the EBS program, we attempt to examine as well how the effect of the EBS e-learning program differs among students with different ability and regions with heterogeneous educational environment. We employ a conditional quantile regression model to identify such relative effects of the EBS program. The result of the quantile regression analysis is expected to provide important policy implications towards reducing the educational gap among students and regions.

3. The Model

The effect of the EBS e-learning program on students' academic performance can be estimated by the following regression equation:

$$Y_i = \beta_0 + \beta_1 EBS_i + \beta_2 X_i^I + \beta_3 X_i^H + \beta_4 X_i^S + \epsilon_i. \quad (1)$$

Here, the dependent variable is student i 's standardized test scores that she/he obtained in each subject in the CSAT. EBS_i , the most important variable in this study, is a dummy variable indicating whether the EBS program was the primary supplementary learning mode that the student i took while studying after school. X_i^I is a vector of individual characteristics of student i , including gender, interest in the subject of interest, self-evaluated aptitude in the subject, student i 's relative standing among all classmates in his/her grade in the subject, expressed in percentile and evaluated by the teacher. This relative standing evaluated by the teacher can play an important role to control for the student's ability which may contaminate the true effect of the EBS program. X_i^H is a vector of household characteristics including household income, parents' education, total expenditure on private tutoring for children in the household, and the region in which the student lives. X_i^S refers to school attributes, such as the overall degree of students' satisfaction for their school lives, the overall degree of students' interest in classes, the overall students' academic atmosphere, the overall condition of school buildings and classrooms, and the existence of a computer lab. The most important parameter estimate in equation (1) is β_1 , which indicates the impact of an EBS program on the student's performance in the CSAT, holding other factors constant.

The specification (1) identifies only the 'average' effect of the EBS e-learning program. In the next step, we employed a conditional quantile regression (QR) model to examine how the effect of the EBS program varies by student's ability, that is, to figure out which ability group of students received more help from the EBS program.

While the conventional ordinary least squares (OLS) estimation minimizes the sum of squares of the residual, a conditional quantile regression solves for the parameter estimates so that the sum of absolute residuals is minimized with different weights placed on each residual depending of the sign of the residual (for a detailed discussion for a conditional quantile regression, refer to Buchinsky (1998), Koenker & Basset (1982), Koenker & Hallock (2001)). The q -th quantile estimator β_q is the solution to minimize the following loss function:

$$Q(\beta_q) = \sum_{i: u_i \geq X_i' \beta} q |u_i - X_i' \beta_q| + \sum_{i: u_i \leq X_i' \beta} (1-q) |u_i - X_i' \beta_q| \quad (2)$$

QR estimation has several advantages over least squares estimation. One of the advantages of a QR estimation is that QR estimators are robust to model specification even when there are some outliers in the data and the residual does not follow a normal distribution. More importantly, a QR estimation can characterize the data in a richer manner. While the OLS technique estimates only a linear conditional mean function, a QR estimation measures the impact of explanatory variables at various conditional quantiles. In this sense, a QR estimation can be an appropriate method for the current study to figure out the impact of the EBS e-learning service on the performance of students at different percentiles of ability level.

4. Data

The data to be used in this study comes from Korean Education and Employment Panel (KEEP). KEEP is a longitudinal data gathering information from students who were in the third year in middle schools and high schools in 2004 (for a detailed introduction, visit the KEEP website http://www.krivet.re.kr/ku/ha/prg_kuFAADs.jsp). These

students were selected from representative schools that were chosen from the population of schools in Korea through a stratified randomization method. The number of students chosen in the initial year, 2004, and surveyed in the subsequent years was 2,000 for middle school, general high school, and vocational high school, respectively. The main purpose of KEEP is to provide detailed knowledge of the transition of students to higher education and labor market after graduation. KEEP is managed by Korea Research Institute for Vocational Education and Training, a government research institute.

The KEEP data provides valuable information for this study. In particular, KEEP contains useful information on private education, including the EBS e-learning, that each student takes, and CSAT scores for high school students, along with various personal, household, and school characteristics. We took for the analysis the students who were in the third year in general high schools in the first year of survey, 2004, and merged their information with the second round (2005) information to find their CSAT scores. The final sample consists of 1,208 general high school students, dropping samples who have missing information in any of the variables used in the regression analysis. The description of variables used in the empirical analysis is shown in Table 1.

Table 1. Description of variables

Variable	Description
<u>Student level</u>	
Took an EBS CSAT program	1 if took an EBS CSAT program as the primary means of tutoring and 0 otherwise
General major	1 if general major and 0 if vocational major
Male	1 if male and 0 if female
Interest in the subject*	1 if interested, and 0 otherwise
Aptitude in the subject*	1 if capable, and 0 otherwise
Self-study time	Weekly average number of hours for self-studying net of regular school hours and private tutoring
Percentile of the student's GPA	Percentile of the student's GPA in the grade, evaluated by teacher
<u>Household level</u>	
Talking time with parents	Daily average number of hours in which the student talks to parents
Household income	Average monthly household income in the last year (in KRW 10,000)
Total tutoring expenditure	Average monthly household tutoring expenditure in the last year (in KRW 10,000)
Father's educ. = 2-year college	1 if father's final education is a vocational college, and 0 otherwise
Father's educ. >= 4-year college	1 if father's final education is a 4-year college or higher
Mother's educ. = 2-year college	1 if mother's final education is a vocational college, and 0 otherwise
Mother's educ. >= 4-year college	1 if mother's final education is a 4-year college or higher
Number of children	Number of children in the student's household
Region	Converted into 3 dummy variables for Seoul, metropolitan cities and other cities
<u>School level</u>	
Students satisfied with school life*	1 if strongly agree or agree, and 0 otherwise
Students interested in class*	1 if strongly agree or agree, and 0 otherwise
Good academic atmosphere*	1 if strongly agree or agree, and 0 otherwise
Classrooms in good condition*	1 if strongly agree or agree, and 0 otherwise
Good computer lab*	1 if strongly agree or agree, and 0 otherwise
Library has large volume*	1 if strongly agree or agree, and 0 otherwise

* In the KEEP survey, respondents are asked to answer in this question in a 5-point scale, taking 1 when strongly disagree through 5 when strongly agree. Then, the 5-point scale answers were recorded in a dummy variable taking 1 if the answer is 4 or 5 and 0 otherwise.

5. Regression Results

The Table 2 through Table 4 display regression results which show the relative CSAT performance in the areas of Korean language, math, and foreign language, respectively, for those who have taken an EBS e-learning program as the primary supplementary education, compared with those for whom the EBS program was not the primary mode of supplementary private education. The first column in each table represents the OLS result, while the rest three columns describe the quantile regression results for the effect of EBS program evaluated at 25th, 50th, and 75th percentiles, in the order.

The results in those tables generally indicate evidence that the EBS e-learning program for CSAT does have a positive impact on students' academic performance. In addition, the effect of the EBS program appears to be larger for students at the bottom in the ability distribution than for those at the top. Specifically, in the regression of Korean language CSAT scores, the OLS result in the first column of Table 2 suggests that, *ceteris paribus*, the standardized CSAT score is 5.31 points higher on average for students who have taken an EBS program as the main source of supplementary study than for those who have not. The QR result in the second column implies that the EBS program produces a positive effect of 6.64 points at 25th percentile. The estimated effect of the EBS program is still positive and statistically significant at higher percentiles, but the size of the effect declines with quantiles. It is 4 points at 50th percentile and decreases to 2.36 at 75th percentile. That is, the EBS program appears to bring a stronger positive effect to less-able students than to abler students.

A similar pattern in the results appeared in the analysis of math and foreign language scores. As shown in Table 3, the OLS estimate of the EBS program effect is very large at 11.84 points, while it is 8.39 points at 25th percentile, 5.68 points at 50th percentile, and 3.95 points at 75th percentile. In foreign language area, as illustrated in Table 4, the estimated effect of the EBS program amounts to 3.34 points in the OLS analysis, while the QR results indicate 3.91 points, 2.59 points, and 2.36 points at the bottom quartile, median quartile, and top quartile, respectively.

Combining all the regression results, it may be concluded that the EBS program generally has a positive impact on students' academic performance, and that the positive effect is larger in math and for students at the bottom of the ability distribution. One possible explanation for the inverse relationship between the estimated effect of the EBS program and students' ability may be attributed to the pattern of private education that varies among students with different ability. According to a statistics of the sample, which is not reported in this paper, students with higher ability tend to spend more on private education. The higher performance of these students at the top of the ability distribution might be attributed to this larger expenditure on private education. In this case, the effect of the EBS program can decrease more substantially for those abler students when the private education expenditure is controlled for. Another explanation for the inverse relationship between the size of the EBS program effect and students' ability would be the fact that the EBS program is offered to general students, that is, it is not a customized one to serve students with different ability differently. This undifferentiated feature of the EBS program in delivering knowledge may help students at the middle and bottom of the ability distribution, but not so much for abler students.

Table 2. Regression result of standardized CSAT score in language

	OLS		Conditional Quantile Regression					
	Coef.	t-val.	25 percentile		50 percentile		75 percentile	
			Coef.	t-val.	Coef.	t-val.	Coef.	t-val.
EBS CSAT program	5.31	4.77***	6.64	4.91***	4.00	2.68***	2.36	2.50**
General major	22.94	15.69***	23.79	13.43***	26.71	13.67***	27.20	22.47***
Male	4.04	3.72***	3.60	2.68***	3.06	2.12**	3.23	3.67***
Interest in the subject	7.65	6.86***	7.55	5.50***	6.02	4.03***	4.70	5.02***
Aptitude in the subject	7.09	5.00***	8.21	4.87***	8.29	4.40***	7.20	5.98***
Self-study time	1.14	4.46***	1.65	5.27***	1.09	3.17***	0.62	2.86***
Percentile of GPA	-0.11	-6.24***	-0.14	-5.94***	-0.15	-6.24***	-0.15	-11.08***
Talking time with parents	-0.40	-0.24	2.14	1.07	-0.50	-0.22	-0.34	-0.25
Household income	1.75	0.64	2.83	0.87	3.22	0.89	2.30	1.01
Total tutoring expenditure	0.01	1.02	0.02	1.29	0.01	0.80	0.00	0.50
Father's educ. = 2-year college	1.19	0.70	3.57	1.77*	1.69	0.74	-1.07	-0.74
Father's educ. >= 4-year college	2.30	1.09	2.64	1.05	2.29	0.81	-0.91	-0.50
Mother's educ. = 2-year college	0.59	0.41	-2.69	-1.57	-1.02	-0.52	1.73	1.41
Mother's educ. >= 4-year college	4.48	1.80*	3.76	1.25	2.77	0.84	7.02	3.39***
Number of children	-0.20	-0.24	0.04	0.04	0.23	0.21	0.28	0.40
Seoul	4.67	2.52**	7.30	3.31***	3.96	1.60	4.07	2.69***
Metropolitan cities	3.26	2.00**	5.52	2.78***	3.01	1.38	1.14	0.85
Other cities	5.72	3.74***	8.68	4.72***	4.60	2.25**	1.67	1.32
Students satisfied with school life	0.40	0.35	-0.91	-0.64	-0.34	-0.22	1.20	1.27
Students interested in class	-0.85	-0.70	0.46	0.31	-1.43	-0.88	-2.36	-2.37**
Good academic atmosphere	3.07	2.45**	1.43	0.96	4.24	2.52**	4.06	3.89***
Classrooms in good condition	-1.17	-1.04	-0.12	-0.09	-0.57	-0.38	-2.13	-2.28**
Good computer	0.92	0.82	0.30	0.23	-1.18	-0.79	0.00	0.00
Good library	-1.03	-0.94	1.16	0.89	-0.58	-0.39	-0.40	-0.44
Obs	1208		1208		1208		1208	
R2	0.40		0.30		0.30		0.28	

Note: ***, ** and * are statistically significant at 1%, 5% and 10% level. The estimate of the constant term is not reported

Table 3. Regression result of standardized CSAT score in Math

	OLS		Conditional Quantile Regression					
	Coef.	t-val.	25 percentile		50 percentile		75 percentile	
			Coef.	t-val.	Coef.	t-val.	Coef.	t-val.
EBS CSAT program	11.84	5.60***	8.39	3.71***	5.68	4.18***	3.95	2.51**
General major	15.07	6.00***	16.32	5.80***	10.48	6.46***	12.43	6.69***
Male	5.98	3.22***	4.07	1.96**	2.01	1.68*	0.26	0.19***
Interest in the subject	11.30	5.40***	8.86	3.91***	6.35	4.72***	6.79	4.47***
Aptitude in the subject	11.51	4.03***	9.83	3.20***	10.47	5.72***	12.21	5.87***
Self-study time	2.43	5.40***	1.54	3.11***	1.55	5.34***	1.76	5.39***
Percentile of GPA	-0.15	-4.90***	-0.12	-3.37***	-0.11	-5.38***	-0.14	-6.50***
Talking time with parents	-2.24	-0.78	-2.88	-0.90	-1.38	-0.75	-1.65	-0.78
Household income	-0.92	-0.20	0.61	0.11	-1.60	-0.53	-0.58	-0.17
Total tutoring expenditure	-0.03	-1.49	-0.02	-1.09	0.01	0.48	0.00	-0.23
Father's educ. = 2-year college	7.44	2.52**	7.95	2.48**	4.67	2.45**	5.87	2.68***
Father's educ. >= 4-year college	5.77	1.58	7.70	1.93*	5.15	2.19**	6.79	2.56**
Mother's educ. = 2-year college	-2.64	-1.05	-1.28	-0.47	-1.81	-1.11	-3.56	-1.88*
Mother's educ. >= 4-year college	0.44	0.10	-2.93	-0.62	-0.50	-0.18	3.64	1.18
Number of children	2.74	1.90*	2.62	1.54	0.50	0.54	-0.27	-0.25
Seoul	10.08	3.16***	9.54	2.67***	4.49	2.20**	2.17	0.93
Metropolitan cities	3.20	1.14	4.29	1.38	3.31	1.83*	6.22	3.04***
Other cities	8.71	3.30***	7.78	2.69***	3.18	1.87*	2.92	1.52
Students satisfied with school life	0.11	0.05	-0.86	-0.39	-0.36	-0.28	-1.29	-0.88
Students interested in class	0.64	0.30	1.85	0.80	0.33	0.25	-0.38	-0.24
Good academic atmosphere	4.43	2.05**	4.35	1.82*	3.04	2.18**	3.60	2.25**
Classrooms in good condition	-0.90	-0.47	-0.95	-0.44	-2.33	-1.87*	-1.35	-0.97
Good computer	-2.18	-1.13	-1.53	-0.72	-0.48	-0.39	-0.67	-0.48
Good library	3.88	2.06**	2.97	1.45	1.14	0.94	1.15	0.83
Obs	1208		1208		1208		1208	
R^2	0.26		0.10		0.14		0.23	

Note: ***, ** and * are statistically significant at 1%, 5% and 10% level. The estimate of the constant term is not reported.

Table 4. Regression result of standardized CSAT score in foreign language

	OLS		Conditional Quantile Regression					
			25 percentile		50 percentile		75 percentile	
	Coef.	t-val.	Coef.	t-val.	Coef.	t-val.	Coef.	t-val.
EBS CSAT program	3.34	3.08***	3.91	4.11***	2.59	2.60***	2.36	2.42**
General major	19.99	14.12***	14.50	11.60***	21.22	16.25***	27.34	21.71***
Male	-3.00	-2.85***	-3.90	-4.15***	-3.62	-3.75***	-2.77	-3.04***
Interest in the subject	5.60	5.19***	4.34	4.52***	6.41	6.43***	6.15	6.24***
Aptitude in the subject	11.61	7.90***	9.14	7.02***	10.51	7.84***	10.81	8.08***
Self-study time	1.58	6.31***	1.95	8.55***	1.63	7.11***	0.76	3.47***
Percentile of GPA	-0.15	-8.71***	-0.13	-7.81***	-0.15	-9.38***	-0.15	-10.33***
Talking time with parents	0.25	0.15	2.50	1.73*	1.33	0.89	0.51	0.35
Household income	-0.28	-0.10	1.48	0.63	1.76	0.73	0.09	0.04
Total tutoring expenditure	0.02	1.35	0.01	0.84	0.00	0.43	0.01	0.80
Father's educ. = 2-year college	2.96	1.77*	4.70	3.21***	3.49	2.26**	2.73	1.79*
Father's educ. >= 4-year college	4.53	2.20**	5.96	3.30***	5.65	2.97***	5.97	3.21***
Mother's educ. = 2-year college	-0.25	-0.17	-0.04	-0.03	-1.11	-0.85	-0.86	-0.67
Mother's educ. >= 4-year college	4.61	1.91*	3.95	1.85*	4.72	2.12**	5.67	2.67***
Number of children	0.76	0.93	0.09	0.12	0.73	0.97	0.59	0.85
Seoul	6.11	3.39***	2.56	1.60	5.47	3.30***	4.26	2.64***
Metropolitan cities	5.76	3.63***	0.66	0.46	4.19	2.86***	3.91	2.82***
Other cities	6.20	4.16***	4.05	3.06***	4.11	2.99***	2.33	1.77*
Students satisfied with school life	-0.32	-0.29	-0.96	-0.99	-1.54	-1.51	-1.05	-1.05
Students interested in class	0.56	0.47	-0.05	-0.05	-0.06	-0.05	0.59	0.55
Good academic atmosphere	2.34	1.91*	3.92	3.62***	3.82	3.41***	2.93	2.67***
Classrooms in good condition	-2.85	-2.60***	-1.01	-1.03	-2.50	-2.49**	-5.37	-5.50***
Good computer	-0.53	-0.49	-1.21	-1.25	0.49	0.49	1.25	1.31
Good library	0.93	0.87	2.04	2.18**	-0.53	-0.54	-1.31	-1.37
Obs	1208		1208		1208		1208	
R2	0.42		0.26		0.32		0.33	

Note: ***, ** and * are statistically significant at 1%, 5% and 10% level. The estimate of the constant term is not reported.

6. Summary and Conclusion

The government-supported EBS e-learning program for high school students in Korea was introduced in 2004 on TV and through internet. The primary purpose of the EBS program was to suppress the growing expenditure on private education. The Korean government strives to raise the practical use of the EBS program by indexing the CSAT questions to the contents delivered through the EBS program. Due to this government effort, the EBS e-learning program is becoming more popular than ever, with more than 80 percent of general high school students using the EBS e-learning service in 2011. However, does the EBS bring a positive impact on students' academic achievement? This study attempted to contribute to the existing literature by examining the effect of the EBS program on high school students' performance in a Korean context.

The empirical results of this study provide positive evidence that the EBS program has a substantial positive impact on high school students' performance. The positive effect appears to be consistent in all areas of CSAT and larger in math. In addition, the quantile regression results indicate that the EBS program provides larger benefits for students at the lower tail of the ability distribution.

The result that suggests a positive impact of the EBS program implies that an expansion of the EBS program may result in the reduction in the private education expenditure in the long run as well because students will rely more on the EBS program which is substantially cheap, compared to other modes of private education. More importantly, the result that less-able students enjoy larger benefits from the EBS e-learning program suggests a positive role of the EBS e-learning service in eliminating educational gap among students with different ability and regions with dissimilar educational infrastructure. However, some argue that it is also very possible that the formal education system may be, on the contrary, subject to the EBS e-learning program when the impact of the EBS program becomes too big (Lee, 2004). So, we need to heed to such voices as well when running and better designing the EBS program in the future.

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