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The impact of a scholarship program on hours of study outside the classroom in elementary school student

El impacto de un programa de becas en las horas de estudio fuera del aula de clase en escolares de educación básica

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Abstract

We analyze the impact of the Mexico City Scholarship Program on the hours of study of boys and girls in basic education. We use a randomized survey to assess its impact on the 2014-2015 school year of the DIF CDMX. We used an approach based on the comparison of a treatment group with a control group, in the context of an equation of a school achievement production function. The OLS and Maximum Likelihood estimation methods are used to ensure the statistical robustness of the estimation of the program's effectiveness. The program allowed the study time to be increased by a little more than one hour daily in the minors of the treated group.

JEL Code: : D04, I28, I38
Keywords: children's hours of study; school scholarship program; instrumental variable method; self-selection bias

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Resumen

Analizamos el impacto del Programa de Becas Escolares de la Ciudad de México en las horas de estudio de niños y niñas en educación básica. Usamos una encuesta aleatorizada para evaluar su impacto en el ciclo escolar 2014-2015 del DIF CDMX. Utilizamos un enfoque basado en la comparación de un grupo de tratamiento con un grupo de control, en el contexto de una ecuación de una función de producción de logros escolares. Se emplean los métodos de estimación MCO y Máxima Verosimilitud para asegurar la robustez estadística de la estimación de la efectividad del programa. El programa permitió aumentar el tiempo de estudio en poco más de una hora diaria en los menores del grupo tratado.

Código JEL: D04, I28, I38
Palabras clave: horas de estudio en niños y niñas; programa de becas escolares; método de variables instrumentales bioprobit; sesgo de autoselección

Introduction

The hours children spend studying positively affect their cognitive development and are reflected in their educational outcomes (Fredrick & Walberg, 1980). Using longitudinal data, Fiorini and Kane (2014) found that time spent in educational activities is the most productive input for developing cognitive skills. Admassie (2002) found that, if work participation exceeds a threshold number of hours, children's educational development can be seriously impaired. The number of hours a child studies outside the classroom is determined by student, household, community, and public policy characteristics (Posel & Grapsa, 2017; Anderson et al., 2001). There is little empirical research on this topic in Mexico. Especially, there are not many studies on the impact of public policy programs supporting education on children's study hours outside the classroom.

The existing literature generally focuses on analyzing the impact of public policy on variables that measure other educational outcomes, such as school performance or attendance. This article investigates the effect of the Mexico City (CDMX) School Scholarship program on the study hours outside the classroom spent by children between the ages of 6 and 14 who are enrolled in a public elementary or secondary school in Mexico City. The Scholarship Program is public and is focused on the population living in areas of high social vulnerability[1]. Specifically, the objective is to evaluate the impact of the Scholarship Program on the number of hours of daily study that children spend at home in vulnerable

[1]According to the program's operating rules, a person is considered vulnerable due to social deprivation when their income is higher than the Welfare Line—which as of August 2014 was a monthly income of MXN 2 586.25—but they suffer one or more social deprivations. Social deprivations are educational backwardness, access to health services, access to social security, housing quality and space, and access to food.

communities in Mexico City. To this end, regression models that control for individual, household, and community characteristics are estimated to identify this impact.

The main input for this research is the 2016 DIF-CDMX School Scholarship Program survey. The survey was specifically designed to evaluate the program's impact in various areas associated with the educational outcomes of participating children. It had a probabilistic sample design with representativeness at the district level for Mexico City. The evaluation of the program's effectiveness followed a comparative approach between two groups. The study hours of a group of students participating in the program at the time of the survey were compared with those of a control group that did not participate in the program, with similar characteristics, but that was on the waiting list to participate in the program.

The comparison between groups will show the program's impact conditional on many observable variables, given that the survey contains explanatory variables of the socioeconomic characteristics of the household, the students, their home environments, their school, and their community. The econometric model to measure the program's effectiveness is a school input equation containing the variables suggested by the theory of the academic achievement production function—study hours outside the classroom—suggested by Glewwe and Kremer (2006) and Glewwe and Lambert (2010). The multiple linear regression model was used with the Ordinary Least Squares (OLS) estimation method and the Bioprobit model with the maximum likelihood method to ensure the correct estimation of the program's effectiveness.

The OLS-based results suggest that the program's impact on out-of-school study hours is null and not statistically meaningful. Nonetheless, given that study hours is a multilevel variable, it is more appropriate to use the Bioprobit model designed for variables of that nature. This model found that the program has a positive and statistically meaningful impact. Children in the treatment group studied 1.34 hours more per day than students in the control group. This implies that the program effectively boosts the study hours of the participating children, as expected from a program focused on promoting school outcomes.

The paper is structured as follows: the second section summarizes the empirical literature on the determinants of study hours. The third section describes the Mexico City Scholarship Program. The fourth section describes the database and presents the descriptive statistics. The fifth section shows the analytical framework and the estimation strategy. Finally, the sixth section offers a discussion of the findings.

The empirical literature

Many studies analyze school dropout rates and the determinants of school performance among children in basic education. Nevertheless, very few studies explain the factors determining the study hours children dedicate to learning outside the classroom. Specifically, how public policy programs affect children's study hours has not been studied. Consequently, there is a window of opportunity to analyze this issue in Mexico—specifically, to evaluate whether a school support program, such as the Mexico City School Scholarship Program, affects the number of hours spent studying by children between the ages of 6 and 14 in Mexico City. The following is a brief review of the literature on this topic.

According to Carroll (1963), the factors that affect the time needed to learn are the student's attitude, their ability to understand instructions, and the quality of the teaching. Fredrick and Walberg (1980) found a positive correlation between time spent learning and academic achievement. Hancock et al. (2013) point out that study time in school is affected by school absenteeism.

Study hours are not only limited to the hours students spend in the classroom but also to the time they spend outside of school. Therefore, homework and study hours at home directly influence academic performance. According to Skoufias et al. (2001), child labor is an important deterrent to school. The authors find that reductions in child labor are largely comparable to increases in schooling. Using longitudinal data, Gebremedhin Borga (2019) found that child labor indirectly affects skill development through reduced study hours. According to Rodriguez et al. (2019) and Valle et al. (2017), there is a progressive increase between the amount of homework done and the use of time. However, if students show little interest in homework and perform poorly, they will spend less time doing it.

According to Hoover-Dempsey *et al.* (2001), parental intervention increases the amount and quality of time children dedicate to their homework. In addition, guardians' participation in academic activities at school has a positive effect on children's performance (Van Voorhis, 2003). This effect is greater when guardians are involved (Murillo & Hernández-Castilla, 2020). Parents with a higher educational level can help their children more with homework (Anderson *et al.*, 2001). Nevertheless, Zhou *et al.* (2020) find that parental involvement in their children's mathematics homework can negatively affect the student's feelings toward homework and, therefore, negatively impact children's academic outcomes.

Scholarship program

The School Scholarship Program for socially vulnerable children in Mexico City is aimed at preventing pupils from dropping out. The program is implemented through the Sistema para el Desarrollo Integral de la Familia de la Ciudad de México (System for the Integral Development of the Family of Mexico City). The target population is children between 6 and 14 years old who are enrolled in public primary or secondary schools and are vulnerable due to social deprivation. The support provided by this public policy program consists of monetary transfers to the children's homes and promoting their participation in recreational and cultural activities.

The eligibility criteria for students to participate are: a) be between 5 and 14 years old; 2) receive primary or secondary education in public schools; 3) have a monthly family income equal to or less than MXN 4 037; 4) have at least 3 years of residence in Mexico City; 5) not have similar scholarships from the federal government or the city government; 6) not have other family members receiving the scholarship. The program is designed in a targeted manner[2]. As the program has a list of potential beneficiaries waiting to participate, the scholarship is only awarded for a maximum of 3 years. In 2016, the School Scholarship Program served 25 500 beneficiaries, and 1 516 students were on the waiting list.

In 2015, it was possible to support up to 25 500 students. This number of participants represents an increase of more than 50% over the target projected when the program started in 2001. In total, since the implementation of the strategy and up to 2015, the program had benefited more than 300 000 families. These figures demonstrate the potential reach of the program and the importance of studying its impact on the educational achievements of the participating children.

Database and descriptive statistics

Database and study population

In 2016, a survey was conducted to analyze the program's impact on the school performance of participating children. The sampling design of the survey is random, probabilistic, and stratified by district in Mexico City. Consequently, the results represent children between 6 and 14 who attended public

[2]The program is socio-spatially confined to public schools in Mexico City and is focused on the inhabitants of this territory who satisfy the criteria indicated in the program.

elementary and secondary schools during the 2014-2015 school year in Mexico City. The database includes socioeconomic information and information on the study habits of 201 children divided into two groups: 104 beneficiaries (treatment) and 97 on the program's waiting list (control). In addition, the database has a section with questions on the characteristics of the child's guardian, household, and community. Figure 1 shows the distribution of the sample.

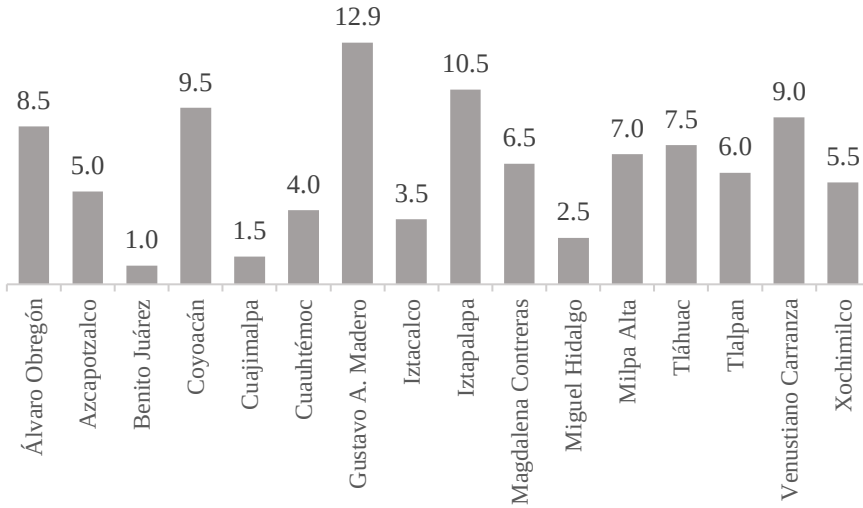

Figure 1. Distribution of the sample by Mexico City district
Source: created by the author based on the Impact Evaluation Survey of the School Scholarship Program (2016)

Descriptive statistics

The indicator of study hours outside the classroom was used for this study. The indicator takes values from 0 to 3 hours per day. Figure 2 shows the children's study hours in the control and treatment groups. It is observed that a higher proportion of children in both groups dedicate one hour to study, 52% and 53%, respectively; 25% of the control children dedicate two hours to study, while 21% of the beneficiaries dedicate the same number of hours. In contrast, a minority do zero or three study hours per day; 11% of the control and 16% of the treatment children do no additional study hours at home. On the other hand, only 6% of the control group and 8% of the beneficiaries do three study hours at home. In general, the surveyed children dedicate on average about one hour a day to study outside the classroom.

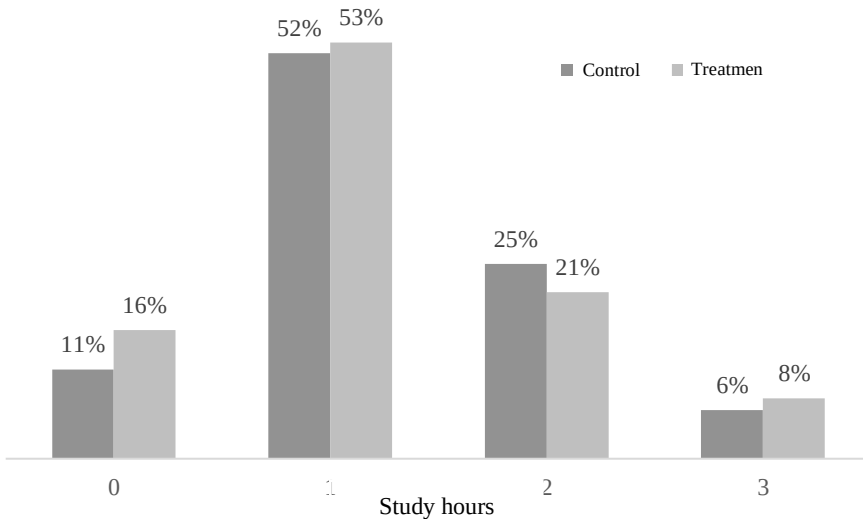

Figure 2. Study hours per day by treatment and control groups
Source: created by the author based on Mexico City School Grant Program Impact Survey (2016)

Table 1 reports the sample's characteristics and some variables used by the literature as explanatory variables for study hours. The first column presents the simple means. The second column gives the results of a statistical test of mean difference between the treatment and control groups, while the third column shows the same tests of mean differences but controls the fixed effects by district.

Table 1, column 1 shows that the sample is composed of 50.7% girls and 49.3% boys. 82.6% of the students responded that they had a good relationship with their classmates. 35.8 % of the students reported missing classes because they were sick during the month prior to the survey during the 2014-2015 school year. 76% indicated they have another health care service other than Seguro Popular. On the other hand, 91.5% of the guardians surveyed are women, 28.2% have more than basic schooling, 64.6% have a job, and 67.3% are married or live with their partner in a common-law relationship. Additionally, 73.6% of the guardians responded that they helped with the children's homework during the 2014-2015 school year. On the other hand, 64.6% of guardians indicated that they are worried that their children will drop out of school due to various difficulties. According to the database, 26.3% of the people surveyed live in their own homes, 40.7% have internet at home, and 24.8% said they use public transportation to go to school. Generally, the people interviewed take an average of 26 minutes to get to school.

Table 1
Descriptive statistics of sample characteristics

Explanatory variables	Mean (Std. dev.) (I)	Fixed effects by participation group P-Value (II)	Fixed effects by district P-Value (III)
Public policy			
Participation in the Scholarship Program	0.517 (0.500)	-	-
Student's characteristics			
Student's gender	0.507 (0.501)	0.436	0.365
Student's age (log)	2.396 (0.191)	0.001	0.001
Study hours per day	1.238 (0.787)	0.546	0.390
Relationship with classmates	0.825 (0.380)	0.742	0.683
Was sick	0.358 (0.481)	0.714	0.755
Medical care (except for Seguro Popular)	0.760 (0.428)	0.059	0.024
Guardian's characteristics			
Guardian's gender	0.915 (0.278)	0.055	0.081
Guardian's education	0.282 (0.451)	0.808	0.999
Guardian's employment	0.646 (0.479)	0.272	0.368
Guardian's marital status	0.577 (0.495)	0.673	0.539
The guardian helped with the child's homework	0.736 (0.441)	0.440	0.554
Guardian thinks there is a risk of dropping out of school due to difficulties	0.646 (0.479)	0.829	0.785
Household characteristics			
Household expenditure (log)	8.111 (0.285)	0.012	0.008
Home ownership	0.263 (0.441)	0.650	0.967
Internet at home	0.407 (0.492)	0.684	0.578
Public transportation: bus	0.248 (0.433)	0.020	0.007
Minutes of transport (log)	3.263 (0.626)	0.163	0.121
Time of participation in the program			
3 years of participation in the program	0.164 (0.684)	0.001	0.002

Explanatory variables	Mean (Std. dev.) (I)	Fixed effects by participation group P-Value (II)	Fixed effects by district P-Value (III)
4 years of participation in the program	0.358 (1.145)	0.000	0.000

Source: created by the author based on Mexico City School Grant Program Impact Survey (2016)

The simple differences test suggests no statistically significant difference between the study hours spent by children in the control and treatment groups. If the selection of program beneficiaries were randomized, this result of the unconditional means difference test could indicate the true impact of the program on children's study hours. Nevertheless, due to the non-randomization of the support among the population, it is necessary to select an estimation method to control for all observable variables associated with study hours using the multiple linear regression model to estimate the impact of the public policy program. This analysis is carried out in the last section of this article.

On the other hand, the data in columns 2 and 3 indicate no significant differences in the socioeconomic characteristics of the treatment and control groups. This suggests that the groups are comparable. Nonetheless, in column 3, when controlling for fixed effects by district, there is a statistically significant difference in children's age, household spending, and access to health services (excluding Seguro Popular). There are also significant differences in the type of transportation students use to attend school.

These statistically significant differences suggest that it is necessary to consider all possible observable variables when estimating with econometric methods to properly assess the program's effect on any school outcome. Consequently, it is more appropriate to use regression models rather than simple mean tests, where estimating the impact unbiasedly by conditioning on several explanatory variables is possible. It is important to control for all explanatory variables in the estimations, including fixed effects, to capture the heterogeneous effects of Mexico City's districts.

Analytical framework and program impact evaluation strategy

To determine the effectiveness of the School Scholarship Program on the out-of-classroom study hours of the participating children, this study is based on the theoretical framework suggested by Glewwe and Kremer (2006) and Glewwe and Lambert (2010). A school achievement production function is proposed, including the number of study hours outside the children's classroom:

$$L = a(Es, A, H, If, E) \tag{1}$$

where L is the educational attainment of the students, which is determined by years of schooling (Es), student characteristics (A), home background (H), inputs to education under family control (If), such as the children's study hours, and school characteristics (E). It is important to point out that these variables may indirectly affect cognitive skills; that is, they may be endogenous variables in Equation (1). If is considered an endogenous variable because parents can modify this input according to their preferences. That is, parents can encourage the study hours that children dedicate to improving their school performance. Thus, the following behavioral equation of study hours per day is obtained:

$$If = i(A, H, E, P) \tag{2}$$

According to Equation (2), study hours are a function of the characteristics of students (A), their households (H), schools (E) and the prices of educational supplies purchased by families (P). Moreover, implementing public sector social programs may influence the characteristics of schools and households. Therefore, it is necessary to include their effect in the behavioral equation of study hours (2). Equations (3) and (4) exemplify the mechanisms by which public policies (PP) and community characteristics (CC) affect school characteristics and the prices of educational supplies.

$$E = e(CC, PP) \tag{3}$$

$$P = p(CC, PP) \tag{4}$$

Substituting Equations (3) and (4) into (2), the following is obtained:

$$If = l(A, H, CC, PP) \tag{5}$$

Equation (5) is an appropriate reduced form to evaluate the impact of the School Scholarship Program on study hours. Thus, the number of study hours minors spend per day is the endogenous variable, while the set of explanatory variables are student, household, and community characteristics, as

well as a variable that captures public policy. Equation (5) can be estimated by estimating the parameters of the simple regression model using the OLS method:

$$I_i = \alpha + \beta \mathrm{A}_i + \gamma \mathrm{H}_i + \delta \mathrm{CC}_i + \varphi \mathrm{PP}_i + \mathrm{ef}_d + \mu \tag{6}$$

where I_i are the study hours of the *i-th* student, and A, H y CC are vectors of exogenous variables that capture the characteristics of the students, the household, and the community, respectively. While PP reflects the implementation of the School Scholarship Program, the variable takes the value of 1 when students are beneficiaries of the program and 0 when they are students who do not participate in the program. ef are the fixed effects by Mexico City district, and μ is the random error term.

In the next section, an OLS model and a Bioprobit model are estimated to analyze the program's impact on children's study hours. The Bioprobit model is appropriate since it is designed for data with a multichotomous dependent variable, such as the number of study hours per day. It is important to mention that the estimates could be biased due to endogeneity problems when variables are omitted. This problem could generate a violation of the exogeneity assumption, $E[\mu \,|x_i] = 0$, of the explanatory variables of the linear regression model, and affect the unbiasedness and consistency of the OLS estimator.

Therefore, the results of the models could lead to incorrect conclusions about the program's true impact (Behrman, 2001). In this case, omission bias is avoided by including the regressors suggested by economic theory and using a randomized survey for the evaluation. The results of the estimations proposed in this section are discussed below.

Results

Table 2 provides evidence of the impact on children's study hours from participation in the Scholarship Program. Two models are used to estimate the above, linear regression (OLS) and Bioprobit (maximum likelihood). The set of explanatory variables, suggested by the literature on the subject, was also used to compare the results obtained with the two different estimation methods. According to the OLS estimates (column 1), the program has no statistically meaningful effect on study hours. Nonetheless, given that the study hours per day variable is multinomial, it is more appropriate to use a model such as Bioprobit instead of OLS.

Column (2) reports the impact estimates with the Bioprobit model. Once it is controlled for the variables suggested by the theory and the most appropriate estimation method is used, the program's positive effect on study hours (1.34 hours per day) is confirmed. This Bioprobit model involves

complementing the program participation variable with the variable of access to health services[3]. In conclusion, the School Scholarship Program positively affects the hours children dedicate to study compared to the control group.

Information on student, home, and community characteristics was also used in the regressions. The variables have the expected signs and agree with the theory and the review of stylized facts from the literature. According to the estimates in Table 2, the study hours are reduced by approximately 0.2 when the student misses school. This could be explained by the fact that absences generate a disengagement of the student from their studies and generally end with them dropping out.

Furthermore, if the student uses the bus as a means of transportation to school, the impact on study hours decreases between 0.16 and 0.48. In other words, study hours are reduced by between a quarter and three quarters of an hour. This is associated with the negative effect of long distances to school on the time available for children to study. Likewise, transportation time also significantly affects study hours. This implies that there are huge costs to students' learning when attending a school far from home. It is notable that access to the internet and tablets does not increase the time spent studying.

Table 2
Estimates of the impact of the Scholarship Program on study hours

Explanatory variables	OLS (1)	BIOPROBIT (4)
Public policy shock		
Participation in School Scholarships	-0.11 (0. 117)	1.34 *** (0.175)
Student's characteristics		
Student's gender	0.06 (0.116)	0.11 (0.167)
Missed class at least once	-0.21 * (0.117)	-0.12 (0.173)
Relationship with classmates	0.16 (0.149)	0.27 * (0.217)
Guardian's characteristics		
Guardian's gender	-0.16 (0.222)	-0.55 (0.317)
Guardian's employment	-0.03 (0.131)	-0.07 (0.191)
The guardian helped with homework	0.16 (0.132)	0.05 (0.193)
Household characteristics		
Household expenditure (log)	0.01	-0.57 *

[3]The variable of access to health services may be a good instrument, since it is correlated with participation in the program, due to the fact that the program is targeted to the most vulnerable population. Therefore, the beneficiary population could also be vulnerable to accessing a health service. This variable is also unrelated to the study hours of the minors.

Explanatory variables	OLS (1)	BIOPROBIT (4)
	(0.223)	(0.320)
Number of inhabitants in the household (log)	0.14	0.17
	(0.207)	(0.301)
Own home	0.06	0.19
	(0.140)	(0.202)
Internet at home	-0.03	0.09
	(0.118)	(0.172)
Tablet at home	-0.15	-0.25
	(0.118)	(0.170)
Minutes of transport (log)	0.22 **	0.16
	(0.112)	(0.166)
Means of transportation: Bus	-0.16	-0.46 **
	(0.154)	(0.223)
Districts		
Districts	Yes	Yes
Constant	0.22	
	(1.808)	

Source: created by the author based on Mexico City School Grant Program Impact Survey (2016)
Nota: * p<0.10, ** p<0.05, *** p<0.01
Standard errors in parentheses

In addition, some characteristics may encourage study hours. For example, if household spending on basic goods increases, children are more likely to reduce their study hours. This finding is explained by the fact that the families supported by the scholarship are low-income, so children will likely have to seek monetary income and devote their time to part-time work or help with household chores. Finally, according to the estimates of this study, if children have a good relationship with their peers, the time they have available to study at home increases between 0.16 and 0.27. That is, study hours increase by between a quarter and an hour.

Conclusions

This paper contributes to the literature on the analysis of children's study hours in basic education in Mexico. More specifically, it examined the impact of a program such as Becas Escolares on the study hours of students in Mexico City. For this purpose, the Impact Evaluation Survey of the School Scholarship Program (2016) was used, as its design allows the characteristics of two groups, treatment and control, to be compared. Two econometric models were used for the analysis: multiple linear regression and Bioprobit.

The Bioprobit model obtained unbiased results. The impact of the program on study hours is positive and statistically significant. That is, the children benefiting from the program do increase their

study hours per day compared to those who do not participate in the program and are comparable individuals. It is important to mention that the results obtained are indicative. Therefore, in order for the School Scholarship Program to have a positive effect on study hours, the program authorities could develop mechanisms such as the formation of clubs to study or do homework at school, pedagogical activities for playing and learning, or talks to make better use of technological tools (internet, tablets, and computers) in student learning, among others.

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