

Unraveling Achievement Trajectories^{*}

-A Longitudinal Analysis of Immigrant and Non-Immigrant Students Across Socioeconomic Groups-

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Abstract

This study employed a time-varying effect model (TVEM) and data from the Korean Education Longitudinal Study 2013 (KELS 2013) to analyze the academic trajectories of Korean, English, and mathematics achievement among students from 5th to 9th grade. The research focused on differences between immigrant-background and non-immigrant students across socioeconomic status (SES) groups. TVEM was utilized to capture the dynamic nature of achievement gaps over time, allowing for a detailed examination of how these disparities evolve across educational stages. The results indicate that non-immigrant students generally outperform their immigrant-background peers, with the gaps being most pronounced in higher SES groups. However, in low SES groups, no significant gaps were found in English and mathematics, suggesting that socioeconomic disadvantages may overshadow immigrant background in these areas. Conversely, a persistent gap in Korean language achievement remains among low SES immigrant students. The study concludes by discussing these findings' implications for policy and practice, emphasizing the need for targeted interventions to address the unique challenges faced by immigrant-background students.

Key words | Multicultural education, Educational inequality, Achievement gap, Immigrant-background students, KELS

1. Introduction

The academic achievement gap between immigrant and non-immigrant students has garnered increasing attention within South Korea's educational landscape. This disparity is frequently attributed to the socioeconomic status (SES) of immigrant families, which tends to be lower than that of their

non-immigrant counterparts. For immigrant-background students, these challenges are often compounded by additional barriers such as language difficulties, cultural adjustments, and potential discrimination (Suárez-Orozco et al., 2010; Oh & Kim, 2018; Song et al., 2018).

In South Korea, the educational challenges faced by students with immigrant backgrounds are particularly pronounced due to the country's relatively recent encounter with a more ethnically and culturally diverse population (Song et al., 2018). Unlike nations with longer histories of immigration, South Korea is only beginning to address the complexities associated with educating students from immigrant backgrounds. These students often come from households that may lack the cultural and social capital necessary to navigate the rigorous academic demands of South Korean schools (Lee et al., 2015).

While the connection between immigrant background, SES, and academic performance has been the subject of extensive research, most studies offer only cross-sectional analyses (Oh & Kim, 2018; Lee et al., 2015). Cross-sectional studies provide snapshots of achievement at specific points in time, but they lack the ability to track changes in academic trajectories as students progress through key educational stages (Kuhfeld et al., 2018). Without longitudinal data, it remains difficult to determine whether interventions targeting the academic achievement of immigrant-background students are most effective during certain developmental periods.

Previous research conducted in other contexts, such as the United States, has yielded mixed findings regarding the academic performance of immigrant-background students. For example, the “immigrant paradox” suggests that some immigrant groups

outperform their native-born peers despite lower SES (Kao & Tienda, 1995). However, whether similar patterns exist in South Korea remains unclear, making this study particularly salient in the global context of immigrant education.

To address this gap, the present study employs a longitudinal approach to investigate the academic trajectories of immigrant and non-immigrant students, focusing on the role of socioeconomic status. Drawing on data from the Korean Educational Longitudinal Study 2013 (KELS 2013), which includes nationally representative samples and standardized test scores in mathematics, Korean, and English, this research aims to offer an analysis of academic development from the fifth grade through eighth grade.

2. Literature Review

The academic performance of immigrant-background students in South Korea has been a subject of growing academic interest and discussion in recent years. A considerable body of research suggests that these students may encounter challenges in their educational journeys compared to their non-immigrant peers (Park & Lee, 2009; Sung et al., 2012). In particular, academic challenges for children from immigrant families may begin at an early stage, with difficulties persisting over time (Lee et al., 2015). Children from immigrant families between the ages of 3 and 5 score lower in expressive and receptive vocabulary compared to their non-immigrant peers (Park & Lee, 2009). This early gap in language development is often regarded as significant, as it may have long-term

implications for academic performance in other subjects.

Research has consistently documented a widening academic achievement gap between immigrant-background students and their non-immigrant peers, particularly after entering elementary school. For example, Oh and Kim (2018) found that immigrant-background students scored lower in Korean, English, and mathematics, with language barriers, limited access to supplementary education, parental education disparities, and fewer home educational resources contributing to these differences. Similarly, Song, Kim, and Ham (2018) analyzed approximately 1,470 students in areas with high immigrant populations in Seoul and Gyeonggi Province, finding that immigrant-background students performed lower academically than non-immigrant students, even when socioeconomic background and private education participation were considered.

Various regional assessments also offer evidence of the academic gap between immigrant and non-immigrant students in South Korea. Studies suggest that immigrant-background students not only display greater variability in academic performance but also tend to achieve lower average scores across subjects such as mathematics, science, and social studies (Kim, 2013; Shin et al., 2012; Lee, 2013; Jo & Kim, 2013). In addition, immigrant-background students are reported to exhibit higher rates of basic competency deficiency and lower rates of excellence in academic achievement (Shin et al., 2012).

Moreover, research in the United States by Kuhfeld et al. (2018) found that racial/ethnic and SES achievement gaps in reading and mathematics not only persist but often grow as students progress through school, with gaps becoming more

pronounced in the later grades. This highlights the importance of examining how SES and ethnic background intersect and impact academic outcomes over time.

Despite extensive research, some scholars argue that the educational gap between immigrant and non-immigrant students may be overstated and not always statistically significant. For example, research using data from the Multicultural Adolescents Panel and the Korean Children and Youth Panel Survey indicates that, for certain groups, such as fifth and sixth graders, the academic gap may be minimal or even disappear upon entering middle school. Park and Lee (2017) caution that societal biases labeling immigrant-background students as underachievers may contribute to their academic struggles rather than inherent differences in ability.

Adding to this complexity, Youn and Kang (2019) examined 3,107 elementary students, including 115 from immigrant families, using data from the Busan Educational Longitudinal Study (BELS). While they initially found lower scores for immigrant-background students in the 4th and 5th grades, the gap largely diminished when controlling for socioeconomic factors such as family income, educational expenditure, and family structure. These findings suggest that socioeconomic conditions, rather than immigrant status alone, may play a more significant role in shaping the gaps.

Further, research in global context has produced mixed results regarding the academic achievements of students with immigrant backgrounds. A phenomenon known as the “immigrant paradox” (Kao & Tienda, 1995) suggests that some immigrant students outperform their native-born peers despite socioeconomic disadvantages. This success is often attributed

to strong family support, high educational aspirations, and cultural values that emphasize academic success. However, it is unclear whether this paradox applies in South Korea due to its unique educational system and societal structure. South Korea's competitive academic environment and focus on standardized testing, combined with its relatively recent experience with large-scale immigration, may result in different patterns of adaptation and academic performance compared to countries with longer immigration histories.

These conflicting findings reveal key limitations in previous research. Many studies rely on cross-sectional data, which does not track changes in students' academic progress over time, thus overlooking dynamic factors like language acquisition and cultural adaptation (Lee et al., 2015; Oh & Kim, 2018). Without considering the growth process, it is challenging to account for dynamic factors such as language acquisition, cultural adaptation, and developmental changes that may influence academic performance over time. Additionally, methodological issues arise from the use of small or regionally limited samples that may not represent South Korea's broader student population (Song et al., 2018; Youn & Kang, 2019). Furthermore, reliance on self-reported academic performance rather than standardized test scores introduces potential biases, undermining the accuracy and validity of the results (Cho & Kim, 2013).

This study seeks to fill current gaps in the literature by employing nationally representative longitudinal data and rigorous analytical techniques to investigate the academic achievement trajectories of students with and without immigrant backgrounds. To explore these issues, the study formulates the following

research questions:

Research Question 1: To what extent do the academic achievement trajectories of students with immigrant backgrounds and non-immigrant students differ across subjects from the 5th grade to 9th grade?

Research Question 2: To what extent do the academic achievement trajectories of students with immigrant backgrounds and non-immigrant students differ across subjects according to socioeconomic status (SES) from 5th grade to 9th grade?

3. Research Method

3.1. Data

The data utilized in this study is drawn from KELS 2013, specifically focusing on students who responded to the survey from the first year (5th grade in elementary school) to the fifth year (3rd grade in middle school). A key strength of KELS 2013 is that it offers a nationally representative sample of 5th-grade students in 2013, allowing for broad generalizations about student populations. The research subject distribution comprises 5,832 non-immigrant background students and 149 immigrant background students. The total sample size is 5,981 students.

One significant advantage of this data is its provision of standardized IRT-scaled scores, enabling time-series comparisons of academic performance. It allows tracking the academic trajectories of students over time (Kim et al., 2013). However, starting from 10th grade, the dataset shifts to a different

scoring method that is not IRT-scaled. This change limits data comparability, making it challenging to reliably examine achievement gaps beyond 9th grade.

In addition, KELS offers valuable information on socioeconomic status (SES) by collecting data on parental occupation, education level, and monthly household income. This allows for the estimation of SES and its potential impact on students' academic development.

3.2. Analytic strategy

This study employs Time-Varying Effect Modeling (TVEM) to examine the evolving academic achievement gap between immigrant and non-immigrant students across socioeconomic strata. TVEM, unlike traditional growth models, allows for the estimation of coefficients that change continuously over the study period. Crucially, TVEM's distinguishing feature lies in its ability to model coefficients as smooth functions of time, enabling a precise and detailed analysis of how relationships between variables unfold at specific temporal points. In a TVEM, the model is expressed as:

$$ACH_{it} = \beta_0(t_{ij}) + \beta_1(t_{ij})x_{ij1} + \dots + \beta_p(t_{ij})x_{ijp} + \epsilon_{it}$$

where each $\beta_k(t)$ (for $k = 0, 1, \dots, p$) is a time-varying coefficient function that changes smoothly over time (t_{ij}). To incorporate a time-varying intercept, this sets the first element of the covariate vector x_{ij} to 1, allowing $\beta_0(t)$ to change over time as a smooth function.

Notably, TVEM leverages the temporal continuity of data by

using smoothing techniques, such as splines, to estimate effects as smooth functions of time. This means that when estimating the effect at a specific time point, TVEM borrows strength from neighboring time points, assuming gradual changes rather than abrupt shifts. As a result, the model can still provide reliable estimates even with fewer cases at certain time points, as the information is pooled across the entire timeline to stabilize the estimates (Lin, Chen, & Shyr, 2008). All analyses were performed using SAS 9.4, with TVEM implemented via the “%normal TVEM” SAS macros, available at methodology.psu.edu (Li et al., 2015).

To address the first research question, this study applies TVEM separately to immigrant and non-immigrant students, tracking achievement gaps in Korean, English, and mathematics from grades 5 to 9. Subsequently, to explore the second research question, this study uses separate TVEM models for each socioeconomic status (SES) group to examine how the immigrant versus non-immigrant gap varies across SES levels. The findings are presented graphically, with intercept parameters and their corresponding confidence intervals plotted together.

3.3. Measure

The dependent variable is academic performance, measured by standardized test scores in Korean, English, and mathematics from 5th to 9th grade. The KELS 2013 dataset uses a vertically scaled measure for comparing academic progress over time, with scores calibrated to an average of 200 and a standard deviation of 40 (Lee et al., 2013).

Immigrant-background students have at least one foreign-

born parent, while non-immigrant students have both parents born in South Korea.

Socioeconomic status (SES) in this study was categorized into three levels—Low, Middle, and High—based on a composite factor score derived from parental education, occupational prestige, and monthly income collected in the first wave (5th grade). These variables were selected based on their established role in educational research as robust indicators of SES (Entwisle & Astone, 1994; Sirin, 2005). The factor score was created using principal component analysis (PCA) to reduce potential multicollinearity and to ensure that the dimensions of SES were adequately represented. The resulting score was then standardized to have a mean of 0 and a standard deviation of 1, with higher values indicating higher SES.

The classification thresholds were determined by standard deviations from the mean, following common practices in SES-related research (e.g., Reardon, 2011). Specifically, students with SES scores below -1 SD were classified as Low SES, those between -1 and +1 SD were classified as Middle SES, and those above +1 SD were classified as High SES. Table 1 shows the distribution of non-immigrant and immigrant-background students across SES groups.

<Table 1> Distribution of Students by immigrant-background and SES Groups

SES Group	immigrant-background(<i>n</i> , %)		Total(<i>n</i> , %)
	Non-immigrant	Immigrant	
Low	1,112 (19.1%)	52 (34.9%)	1,164 (19.5%)
Middle	3,301 (56.6%)	59 (39.6%)	3,360 (56.2%)
High	1,419 (24.3%)	38 (25.5%)	1,457 (24.4%)
Total	5,832 (100.0%)	149 (100.0%)	5,981 (100.0%)

4. Result

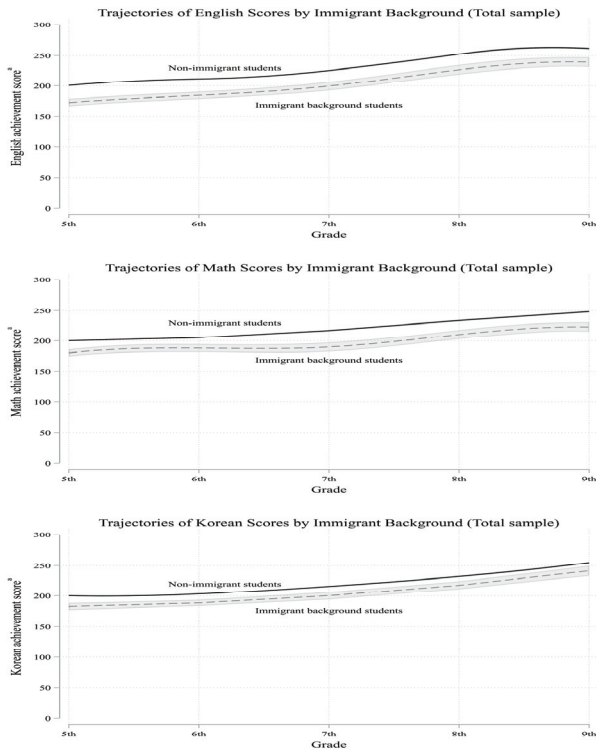
4.1. Achievement trajectories by immigrant-background

[Figure 1] presents the achievement trajectories of the immigrant and non-immigrant students in English, mathematics, and Korean, estimated through a time-varying effect model. The figure illustrates the estimated coefficients for each subject, with the shaded areas representing 95% confidence intervals. Overall, the non-immigrant students consistently achieve higher scores across all subjects, indicating the ongoing challenges faced by the immigrant-background students in the South Korean educational context.

The comparison of academic achievement trajectories between the immigrant-background students and the non-immigrant students across English, mathematics, and Korean reveals several key patterns. In all three subjects, the non-immigrant students consistently demonstrate higher scores than their immigrant counterparts from the 5th to the 9th grade, indicating a persistent achievement gap. This disparity is pronounced in English, where non-immigrant students not only start with a higher baseline in the 5th grade but also continue to outperform immigrant-background students as they progress through middle school. The upward trend for English scores is evident in both groups; however, the increasing rate for immigrant-background students is less steep, suggesting that the gap in English proficiency remains relatively stable over time. Mathematics follows a similar trend, with non-immigrant students consistently scoring higher across all grades. Both groups show an increase in mathematics scores, but the

difference in achievement persists.

The trajectory for Korean scores presents a different pattern. Although non-immigrant students still maintain a lead in academic performance, the gap between the two groups narrows slightly over time. The immigrant-background students exhibit a steady improvement in Korean scores from the 5th to the 9th grade, suggesting that they might be gradually



Note. ^aEach subject's achievement score is represented by the estimated coefficient values obtained through the time-varying effect model.

The shaded areas indicate the 95% confidence intervals.

(Figure 1) Trajectories of English, Math, and Korean scores by immigrant-background from 5th grade to 9th grade

adapting to the language demands of the Korean educational system. Despite this positive trend, non-immigrant students continue to hold an advantage in Korean achievement, though the convergence suggests that some progress is being made.

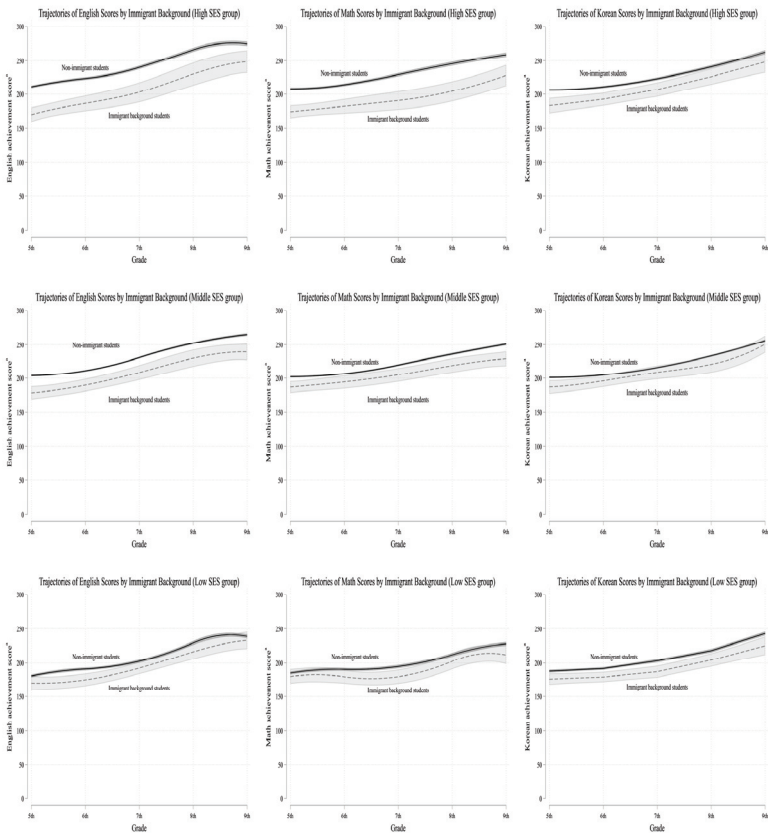
4.2. Trends varying by SES group

Figure 2 illustrates the academic achievement trajectories for English, Math, and Korean scores across different SES groups (High, Middle, and Low) among immigrant and non-immigrant students from 5th to 9th grade. The analysis reveals distinct patterns in the changes of the gaps between non-immigrant and immigrant-background students, varying by SES.

In English, students in the high and middle SES groups consistently show a persistent achievement gap favoring non-immigrant students throughout the 5th to 9th grades. This disparity remains relatively stable over time. Conversely, the low SES group displays minimal differences in English performance between immigrant and non-immigrant students, with the observed variations failing to reach statistical significance.

A similar trend is observed in mathematics achievement. The high SES group maintains a steady gap across all grade levels, consistently favoring non-immigrant students. In the middle SES group, the gap is less pronounced than in the high SES group but still persists over time. However, the low SES group demonstrates negligible differences in math scores between immigrant and non-immigrant students, with variations not statistically significant.

Korean language achievement presents a more complex pattern. Within the high SES group, a substantial initial gap favoring non-immigrant students is evident but gradually diminishes over time, becoming statistically insignificant in the later grades. The middle SES group shows statistically



Note. ^aEach subject's achievement score is represented by the estimated coefficient values obtained through the time-varying effect model.

The shaded areas indicate the 95% confidence intervals.

(Figure 2) Trajectories of English, Math, and Korean scores by immigrant-background and SES group from 5th to 9th grade

insignificant differences. Interestingly, in the low SES group, there is a small yet statistically significant gap in Korean achievement, which remains consistent throughout the observed grade levels.

5. Conclusion

The findings of this study present a complex picture of the academic achievement gap between immigrant and non-immigrant students, revealing that the nature and extent of this gap vary depending on the subject and socioeconomic status (SES). The persistent disparities observed in English and mathematics for the high and middle SES groups align with previous research indicating that immigrant-background students face ongoing challenges in these areas (Oh & Kim, 2018; Song et al., 2018). However, the lack of a significant gap in English and mathematics within the low SES group suggests that SES may play a more critical role in academic achievement than immigrant background itself (Youn & Kang, 2019).

The trends in English and mathematics highlight the complexity of the achievement gap. For the low SES group, the absence of a significant gap between immigrant and non-immigrant students in these subjects suggests that when economic challenges are severe, immigrant background becomes a less distinguishing factor in academic performance. Thus, it is plausible to argue that within low SES groups, economic conditions are the dominant factor influencing academic performance, whereas immigrant background alone does not serve as a primary determinant of disparities (Oh & Kim, 2018).

Interestingly, the results for Korean language achievement show a similar pattern for both high and middle SES groups, where the gap between immigrant and non-immigrant students not only diminishes but almost disappears relatively quickly. For high SES students, this shrinking gap suggests that they gradually adapt to the linguistic demands of the Korean educational system, likely due to their access to ample resources and educational support (Lee et al., 2015). A similar trend is observed in the middle SES group, where the differences decrease rapidly and soon become nearly negligible, indicating that these families also have sufficient resources to support their children's linguistic development and help them overcome initial challenges.

However, the low SES group presents a different and important finding. A notable and consistent gap in Korean language achievement persists, highlighting that socioeconomic disadvantages, when compounded with immigrant background, may pose a significant barrier to academic success. One possible explanation is that low SES immigrant families may lack both the financial resources and cultural capital needed for effective language learning at home (Lee et al., 2015). Additionally, these families might reside in communities with limited exposure to standard Korean language practices, such as neighborhoods with higher concentrations of immigrant populations.

The conclusions drawn here align with studies like Youn and Kang (2019), who emphasize the significant role of socioeconomic conditions in shaping immigrant-background students' academic outcomes. Similarly, these findings resonate with the work of Kuhfeld et al. (2018), which documented the

persistence and growth of academic gaps over time. For high and middle SES groups, immigrant background appears to be a more salient factor in explaining the achievement gaps in English and mathematics.

The findings suggest that policies should address the differential impacts of socioeconomic status on immigrant-background students' academic performance. For high and middle SES families, interventions could focus on enhancing access to supplementary educational resources to close gaps in English and mathematics. Additionally, addressing structural inequalities, such as improving educational resources in low-income areas, is crucial. This comprehensive strategy would promote equity by providing tailored support to immigrant-background students across various socioeconomic backgrounds, ultimately fostering improved academic outcomes and integration.

This study has important limitations to consider. One key constraint lies in the sample composition; the KELS 2013 data, although nationally representative of 5th-grade students, does not fully capture the immigrant-background student population. Moreover, despite TVEM's advantages in handling smaller sample sizes and providing insights into how achievement gaps evolve over time, the relatively small sample of immigrant-background students may limit the statistical robustness of the findings. Nonetheless, this study makes a significant contribution to the field by offering a pioneering longitudinal analysis of academic trajectories in South Korea, filling a critical gap in existing research (Kuhfeld et al., 2018).

Another limitation of this study is the assumption of homogeneity among immigrant-background students, as the

dataset lacks detailed information on factors such as countries of origin, length of residence, and family language practices, limiting the ability to account for this diversity in the analysis. Future research should aim to incorporate more granular data on cultural and linguistic backgrounds, as well as other relevant characteristics, to better understand how these factors influence academic trajectories and contribute to the observed achievement gaps.

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성 명 강충서

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Ⅰ 국문초록

사회경제적 지위 집단에 따른 이주배경 학생과 비이주배경 학생 간 성취 격차 궤적 분석

강충서
(전북대학교)

이 연구는 시간가변효과모형과 한국교육중단연구 자료를 활용하여 초등학교 5학년부터 중학교 3학년까지 SES 집단별 이주배경 유무에 따른 국어, 영어, 수학 성적의 변화 양상을 분석했다. 전반적으로 비이주 배경 학생이 모든 과목에서 이주 배경 학생들보다 일관되게 높은 성적을 보이는 것으로 나타났다. 그러나 이러한 추세는 SES 집단과 과목에 따라 다른 양상을 보였다. 높은 SES와 중간 SES 집단에서는 영어와 수학 과목에서 지속적인 성취 격차가 관찰됐지만, 낮은 SES 집단에서는 이 두 과목에서 유의미한 차이가 발견되지 않았다. 반대로, 국어 과목에서 낮은 SES 집단의 경우 이주배경 학생이 지속해서 낮은 성취도를 보이고, 높은 SES 집단에서는 두 집단 간 차이가 고학년이 되면 거의 사라졌다. 이러한 결과는 이주배경에 따른 학업 성취 격차를 해소하기 위해 과목별로 사회경제적 요인과 이주 배경 간의 상호작용 효과를 긴밀하게 살필 필요를 시사한다.

[주제어] 다문화교육, 교육불평등, 교육격차, 이주배경학생, 교육중단연구

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