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Hierarchical Linear Modeling of Academic Achievement: An Empirical Study of Student, Teacher, and School Factors

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النمذجة الخطية الهرمية للتحصيل الأكاديمي: دراسة تجريبية للعوامل المتعلقة بالطلاب والمعلمين والمدارس

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Abstract:
This study aims to examine student-, teacher-, and school-level factors' effects on mathematics achievement using a hierarchical linear model (HLM). These factors are derived from a combination of manifest and latent variables, which rely on the context of the time and schooling. A standardized survey was administered to a representative sample of 300 female and male students from 10 schools. The survey included demographic data like age, sex, educational level, and socioeconomic status, as well as academic achievement measures. The data were examined using an HLM model to ascertain the relative importance of student level, school, and teacher on students' achievement in mathematics. The outcomes indicated that factors related to students were the most critical, accounting for 68% of the variation in achievement, followed by school factors at 18%, and finally teacher factors at 14%. These results support that individuality in the student is the most important explanation for variability in achievement but indicate the importance of the school setting and that of the teacher as facilitative but comparatively less influential factors.

Keywords: Academic Achievement, Hierarchical Linear Modeling, Educational Data, Multi-Level Analysis.

الملخص
تهدف هذه الدراسة إلى فحص تأثير العوامل على مستويات الطلاب والمعلمين والمدرسة على التحصيل في الرياضيات، وذلك باستخدام النموذج الخطي الهرمي (HLM). تم اشتقاق هذه العوامل من مزيج من المتغيرات الظاهرة والكامنة التي تعتمد على سياق الزمان والدراسة .تم تطبيق استبيان موحد على عينة تمثيلية مكونة من 300 طالب وطالبة من 10 مدارس.

تضمن الاستبيان بيانات ديموغرافية (مثل العمر، والجنس، والمستوى التعليمي، والحالة الاجتماعية والاقتصادية) بالإضافة إلى مقاييس التحصيل الأكاديمي .تم تحليل البيانات باستخدام نموذج HLM لتحديد الأهمية النسبية لمستوى الطالب، والمدرسة، والمعلم في تحصيل الطلاب في الرياضيات. أشارت النتائج إلى أن العوامل المتعلقة بالطلاب هي الأكثر أهمية، حيث تفسر 68% من التباين في التحصيل. تلتها عوامل المدرسة بنسبة 18%، وأخيراً عوامل المعلم بنسبة 14.%. تدعم هذه النتائج فكرة أن الفردية لدى الطالب هي التفسير الأكثر أهمية للتباين في التحصيل، لكنها تشير في الوقت نفسه إلى أهمية البيئة المدرسية ودور المعلم كعوامل مساعدة، وإن كانت أقل تأثيراً نسبياً.،

الكلمات المفتاحية: التحصيل الأكاديمي، النمذجة الخطية الهرمية، البيانات التربوية، التحليل متعدد المستويات.

Introduction

The Academic achievement and advancement are among the most important goals of educational processes at all levels and across all sectors and are the cornerstone of achieving sustainability in education. As all sectors strive to achieve sustainability and development, numerous studies and research efforts are directed toward formulating ideas and strategies that will improve academic achievement in general, and mathematics. Mathematics is one of the most important sciences, due to its ability to organize ideas and present them sequentially and interactively. Through it, students acquire a wide range of skills at various educational levels. Mathematics is not just numbers or equations; it is a language that addresses thinking and logic, and it intervenes in all areas of life, including business, engineering, economics, data analysis, programming, coding, and artificial intelligence. No practical, scientific, or academic application is devoid of reliance on mathematical sciences. For these reasons, the importance of mathematics lies in its being the core of all sciences, in the development of logical and analytical thinking, and as a fundamental component of most life activities [1].

This study aims to identify and analyze the factors influencing students' academic achievement, and to determine the weight of each factor according to its importance and impact. It also aims to analyze and evaluate the obstacles and challenges facing the academic achievement process, and to provide the necessary solutions and proposals to overcome them. This study aims to identify the factors influencing teachers' attitudes toward the use of artificial intelligence techniques, such as experience and qualifications, analyze the impact of different levels (student, class, school) on academic achievement, and evaluate the effectiveness of hierarchical linear models (HLM) in analyzing complex educational data [2].

Despite the importance of this study, it is not comprehensive. It covers many aspects, addresses challenges and obstacles, and offers solutions and proposals. However, there are several obstacles and challenges associated with the research problem, including:

Teachers' attitudes, both positive and negative, toward the use of different teaching techniques and methodologies related to this type of study vary, achieving accurate, positive results free of bias. This is due to the diversity of assessment and teaching methods, the diversity of factors influencing student performance, and the differing perspectives of teachers, students, and parents. This may also be due to previous studies, some of which have biased their findings toward certain factors and points. This bias may be the result of differences in environment, culture, and other factors [3].

Teachers' attitudes, both positive and negative, toward the use of different teaching techniques. In different schools and with different levels of students, it was necessary to use a methodology that yielded objective and accurate results, as well as an appropriate assessment mechanism, given the diversity of assessment methods and approaches [4].

Theoretical background and basic concepts

This section will address the most important basic concepts related to the study, through which the reader can gain insight into the study's importance, objectives, procedures, and key findings. It will also provide a theoretical background by reviewing and critically analyzing some previous studies related to the topic, and identifying the strengths, weaknesses, and points of difference with this study.

Theoretical background

Improving academic achievement is one of the most important and prominent indicators by which the effectiveness of educational systems can be evaluated. Like other indicators, there are multiple factors influencing academic achievement. The most important of these factors are the student's level, the effectiveness of educational systems, teaching methods, and teacher attitudes, in addition to the student's academic level, environment, and socioeconomic status. Furthermore, all of these factors, regardless of their diversity, can be distributed across three different levels: student, teacher, and school. Therefore, linear regression models were used to determine the extent to which these factors are related to the three levels, as well as the correlation between them, and to determine the regression relationship between them, assuming independence of observations. This may not be useful in some cases, especially in educational data characterized by a hierarchical nature Twomey [5].

Therefore, hierarchical linear models were used. Hierarchical linear models (HLMs), also known as multilevel models, represent a significant development in the analysis of this type of data. These models

are characterized by their ability to influence multiple factors simultaneously while preserving the natural structure of the data. They also provide more accurate and interpretable estimates, particularly regarding differences in academic achievement between individuals and groups. Therefore, this study highlights the importance of hierarchical models through a simulation-based study, explaining how these simulations work and how they operate in virtual educational environments that reflect the characteristics of real-world data.

Basic Concepts

In this section, some basic concepts related to the study will be presented, as follows:

1. Academic achievement:

Academic achievement can be defined as the outcome of an educational process, assessed and measured through tests and assessments that determine the extent to which students have acquired knowledge and skills and the extent to which their academic achievement has improved. Therefore, academic achievement is one of the most important indicators by which academic achievement in general, and academic achievement in mathematics, can be evaluated.

It is the result of the educational process and is usually measured by students' scores on tests or assessments. It is an indicator of the extent to which the student has acquired knowledge and skills [6].

2. Hierarchical Linear Models (HLM):

It is a set of vital statistical tools that can be used to analyze data containing different levels, influenced by a set of implicit and explicit variables. Through these models, the impact of variables at each level, whether student, teacher, or school, can be clarified. The correlation between each variable and each level, as well as the relationship between each level and the next, can be determined. The linear regression relationship between them, its direction, and its degree of strength can be determined, [7].

3. Hierarchical data structure:

A hierarchical data structure is one that organizes data so that smaller units are subordinate to larger units. For example, in this study, the smaller units are the students, who are subordinate to a larger unit, the classroom, which is subordinate to a larger unit, the school. This hierarchy results in internal connections that are explicit in many cases and implicit in others. Through this hierarchical structure and organization, the relationships between each level can be analyzed and identified [8].

4. Simulation:

Simulation is a virtual process in which a set of data is created, formulated into mathematical models, and analytical methods are analyzed and evaluated in various controlled environments without the need for real data. However, it should be noted that this environment is virtual, and the data is not real. It is real data, despite its being unreal. It may be data from transaction studies or past experiences [9].

5. Contrast, consistency, and harmony

These are standards and measures by which data is analyzed. Variance is the difference resulting from a group of variables, levels, or within the same level. From this variance and statistical differences, statistical significance can be determined through what is called the coefficient of variation (F). The same applies to consistency, where there must be internal consistency between the elements of one level and external consistency between the levels that follow. For other levels, this consistency is measured through what is known as Cronbach's alpha coefficient, but its cutoff value is 75%.

Consistency and significance can be expressed through the degree of consistency of the data with each other, as well as their significance and validity, by determining what is called the significance coefficient (p-value), whose threshold value is 5%. The higher the threshold value, the less significant and consistent the data are, and vice versa.

6. Fixed and random effects:

It is a set of transactions that can be divided into:

- Constant coefficients: Effects that are assumed to be constant across all units.
- Random coefficients: Effects that vary from one unit to another (such as the effect of a teacher).

Through these transactions and their relationship to variables, the effect of different levels (such as student, class, school) on academic achievement can be analyzed and the strength and direction of this effect can be determined using what is known as the correlation coefficient.

Factors affecting the academic achievement process

There are many factors that affect the academic achievement process and they can be classified as: A to 3 integrated levels according to the Hierarchical Linear Models (HLM), which are: written in this section. A simple strategy to follow is to use keywords from your title in first few sentences.

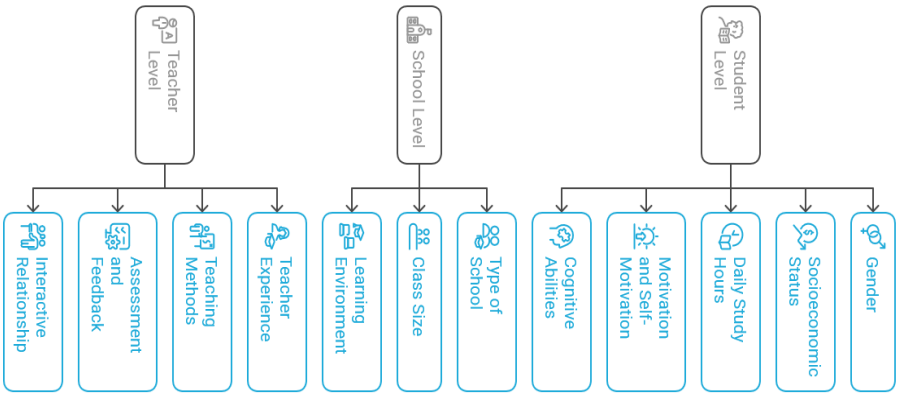

Figure 1: Factors Affecting Academic Achievement**.**

Student level (Level 1)

1. Gender: The student's gender may sometimes have an impact on the level of achievement. We find that the level of achievement of females is often higher than the level of achievement of males.
2. Socioeconomic status: Higher income and higher socioeconomic status of the family are associated with higher educational attainment, which affects academic achievement.
3. Daily study hours: Daily study hours, whether studying at school or reviewing lessons, are linked to improved academic performance.
4. Motivation and self-motivation: Motivation and self-motivation undoubtedly have a significant impact on students and help them integrate and engage in learning more effectively.
5. Cognitive abilities: It has a strong impact, especially when it comes to concentration, processing speed, intelligence, skill, speed of analysis, and intuition.

School level (Level 2)

1. Type of school: The type of school is an important factor, as it is well known that private schools provide better resources and support tools than public schools.
2. Class size: Private schools often provide more interaction space and fewer students per class than public schools.
3. Learning Environment: Private schools provide a more effective learning environment than public schools, whether in terms of administrative policies, the organization of the educational process, or the provision of technological resources and infrastructure such as laboratories, books, and equipment.

Teacher level (Level 3)

1. Teacher experience: Teachers' experience plays a major role in determining interaction and improving improvement.
2. Teaching Methods: Teaching and teaching methods are effective factors in enhancing understanding and improving academic achievement.

Traditional Methods

- The Natural Approach: It is founded on understanding before speaking. It is greatly comparable to the language teaching and learning approach, which employs visual and audio resources for teaching and learning the language, especially at the beginner level. It is highly suitable for beginners and reduces the sentiments of horror and anxiety associated with foreign language learning. Its drawbacks are that it is slow, and its development is slow, especially in the acquisition of speaking skills. However, it does not focus on speaking and listening skills, making it less efficient [10].
- The Direct Method: It is a method that considers learning and teaching the laws of rules and mathematical procedures, whether geometric or algebraic.
- The Interactive Communication Teaching Method: It is a method that depends on real communication and interaction through group activities, discussions, and group projects. This method is explained as developing communication skills.
- Task-Based Learning (TBL): This method relies on the execution of real-world tasks by instructing learners on tasks such as planning or solving a specific problem. This method is characterized by developing communication skills and encouraging critical thinking.
- Project-Based Learning (PBL): This method relies on the instruction of language founded on long-term projects, teaching students' specific projects, such as submitting, report writing, and presentations. The method is characterized by facilitating research and collaboration abilities, but it has its disadvantages: it is time-consuming and may not account for grammar sufficiently.
- Exploratory Approach: This method encourages students to discover grammar through examples and experiments. Its most important feature is that it stimulates curiosity and deep thinking.

A. modern methods

- Visual Representation and Teaching Aids: Aids such as graphs, shapes, and cards are used. They help to simplify complex and abstract concepts.
- Real-life connection: Where issues and problems are derived from the student's real life (such as purchases, distances, and time) to make learning more realistic and applicable to the environment.
- Problem-solving approach: Where real-life problems are provided, then students learn to analyze, break down, and solve them.
- This assists in the development of self-confidence and the attainment of higher-order thinking abilities [11].
- Technology utilization: This method relies on education technology programs and software and interactive tools such as artificial intelligence, virtual reality, and augmented reality software. The most important thing about this method is that it assists understanding and allows students to practice themselves. This, on the one hand, and enhances interaction between teachers and students, on the other.
- Blended learning: It is founded on an integration of traditional learning methods and e-learning methods through tools such as virtual classrooms, augmented reality software, virtual reality, and other electronic media. The method is characterized by learning flexibility and improvement in listening abilities. Its drawback, however, is that it requires. High financial and technical competencies that may not be suitable for some learners [12].
- Assessment and feedback: Immediate feedback and continuous assessment improve student outcomes.
- The interactive relationship between teacher and student: one of the most important tools that can be used to improve the level of academic improvement.

Artificial intelligence techniques used in teaching

There are many artificial intelligence techniques that are used in teaching in general and in teaching mathematics. The goal of these techniques is to enhance the learning experience, improve teaching methods, and improve the level of student achievement. Among the most important of these techniques are:
1. Adaptive learning systems: These are a group of systems that rely on a set of artificial intelligence algorithms that analyze student performance and evaluate specialized academic content based on each student's level.
2. Virtual Assistants and Chatbots: These are a set of methods based on technologies that aim to help students perform specific activities, solve specific problems, and develop ideas and innovation processes by understanding the problem.
3. Instant feedback systems: These are tools that analyze students' level and progress and correct errors, [13].
4. Programs: It is a group of programs that depend on specific algorithms. These algorithms solve equations and mathematical problems, as they help students understand the difficult problem and help them analyze it and learn how to formulate the equation and the method of calculation. Among the most important of these programs is EES, which is a program dedicated to solving equations, in addition to other programs such as Math Type.
5. Virtual reality and augmented reality: These are technologies used to provide a 3D interactive environment where realistic scenarios are created for conversation practice and vocabulary learning through existing virtual elements provided by these applications, the most famous of which are Monday VR and Immerse Me.
6. Learning Analytics: These are algorithms and tools that collect and analyze student data to understand their preferred learning styles and identify their strengths and weaknesses. These tools rely on robust testing procedures and grammar and vocabulary exercises. Popular platforms include Edmodo and Blackboard. 9. Self-Assessment Tools: These tools enable students to evaluate themselves according to specific criteria and short, specific tests. They also provide reports on progress and improvement in learning quality. Popular platforms include Quizlet and Kahoot.
7. Deep learning systems: These technologies rely on artificial neural networks. These networks are used to analyze massive amounts of educational data, whether visual, written, or audio texts. By analyzing this data, common errors can be identified.

Strengths and Weaknesses of Previous Studies

Proceeding to the next set of strengths and weaknesses of applying AI techniques in mathematics education, the most apparent of the new socialist majors is the usage of modern tools such as ChatGPT and upcoming AI [12]. This strongly confirms their usefulness in mathematical and educational material, in addition to the diversity of some of the researchers, which makes the results carry more significance. The most common weaknesses involve the small size of tools in some studies, which makes the findings inconclusive. Some studies are also founded solely on data collection, for example, questionnaires, and do not demand research production. There are also deterrents to practical application, such as inadequate

training, low working capacity, and condensed curricula, which reduces the potential for application of these pressures in the learning environment [14].

Methodology and method

A variety of descriptive methodologies were used to describe the data, variables, levels, and outcomes. The quantitative approach was used to collect data, as were hierarchical linear models, evaluation and analysis methods, the analytical approach to analyze results, and the comparative approach to compare results. The primary approach was "Using Hierarchical Linear Models: In Analyzing Educational Data."

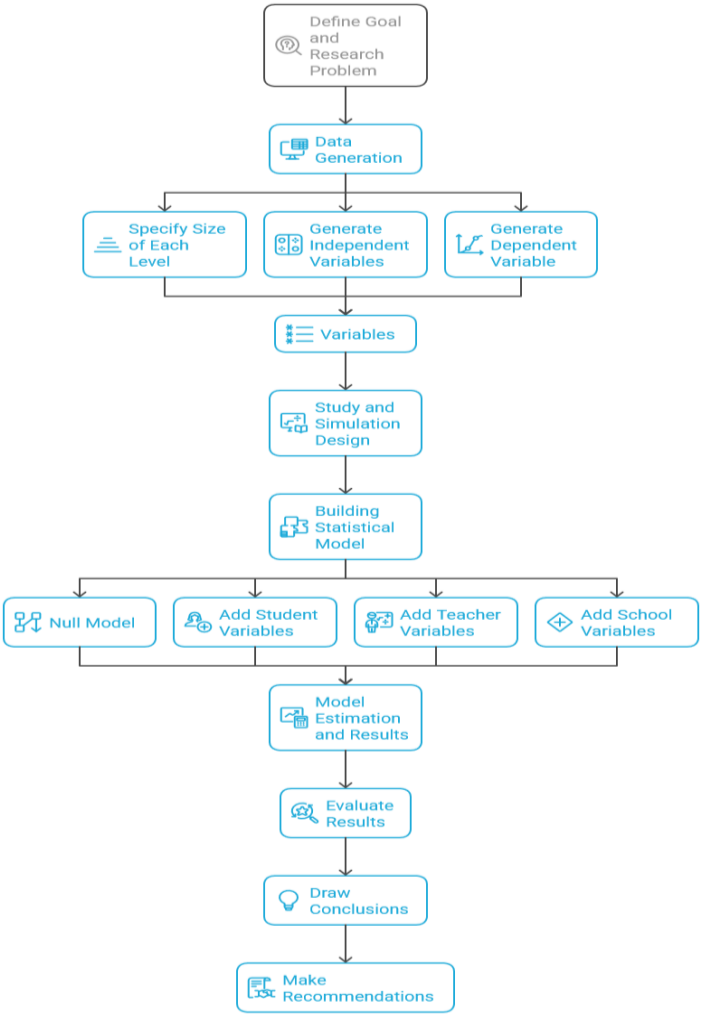

Figure 2: Methodology for Analyzing Educational Data Using HLM.

1. Defining the goal and formulating the research problem

The aim of the study is to create a virtual environment that resembles reality to understand the mechanism of the influence of variables on educational outcomes in a multi-level environment, namely the student, teacher and school, according to a set of implicit and explicit variables related to the student's social and economic status and number of study hours, and to the teacher in terms of years of experience and qualifications, and to the school in terms of the number of its students and the level of experience of teachers and the type of school, whether public or private.

2. Data Generation

- Using a software simulation (such as R, Python, SPSS, or even Excel):
- Specify the size of each level (e.g., 300 students, 30 teachers, 10 schools).
- Generates values for independent variables (X) from logical distributions (such as normal or binomial).
- Generate the dependent variable (Y) such as "math score" using an HLM equation including:
- Fixed effects
- Random effects
- residual error
- equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k + \varepsilon$$

Where:

Y is the dependent variable.

$X_1, X_2,...,X_k$:are the independent variables β_0 is the constant or the intercept of the axis.

$\beta_1, \beta_2,...,\beta_k$:are the regression coefficients that represent the effect of each independent variable on the dependent variable

ε is the random or error term

Variables:

Level 1: Student (300 students)

- Gender (0 = male, 1 = female)
- Socioeconomic status (standardized scale)
- Number of daily study hours

Level 2: Teacher

- Number of years of experience
- Academic qualification (0 = Bachelor's, 1 = Postgraduate)
- Weekly class load (number of classes)

Level 3: School

- School type (0 = public, 1 = private)
- Number of students in the school
- Dependent variable
- Mathematics degree

A three-level hierarchical model with random effects at the teacher and school levels was used to simulate the variance resulting from the entire educational environment.

3. Study and simulation design.

Structure:

- Level 1: Student
- Level 2: Teacher
- Level 3: School

4. Building the statistical model (Model Specification)

1) Use an HLM analysis program (such as R using lme4, or HLM software):
   - Null Model: To find out the general variation between schools and teachers.
2) Add variables according to the level hierarchy:
   - First: Student variables
   - Second: Teacher variables
   - Third: School variables

5. Model Estimation and Results

1) Effect size (Coefficient/β)
2) Statistical significance (p-value)
3) Variance components

Intraclass Correlation Coefficient (ICC)To know the percentage of variance between levels (for example: 20% due to the school, 10% due to the teacher, and the rest is up to the student).

Results and discussion

In this section, the results related to the demographic, descriptive and quantitative characteristics of the results are presented, analyzed and evaluated to draw conclusions and make recommendations.

1. Demographic characteristics Analysis

Demographic data presented in the Table 1 exhibit reasonably even split of samples between men and women, where men account for 47% of the sample and women 53%, reflecting good representation of both genders. Aging-wise, most of the sample was grouped within the 21–23 age group at 56.7%, then followed by the 18–20 age group at 32.2%, with the 24+ age group at a minority proportion of 11.1%, reflecting that most participants were young university students. Academically, when referring to the academic year, the sample was also adequately spread across the years, with the highest percentage in the fourth year (28.9%), followed by the third year (26.7%), then the second year (24.4%), with the lowest percentage in the first year (20.0%), which reflects variability of participants across various levels of academism. These data can generate adequate sample diversity in gender, age, and academic year, so statistical analysis is more credible in probing the relationship of these demographic variables with academic achievement. All tables should be inserted in the main text article at its appropriate place.

Table 1: Demographic characteristics statistics.

Variable	Category	Repetition (N)	percentage (%)
Students			
Gender	Male	141	47%
	Female	159	53%
Age	Under 15	42	14%
	From15:18	210	70.00%
	Over 18	48	16.00%
Academic Year	First year	52	17.50%
	Second year	96	32%
	Third year	92	30.50%
	Fourth year	60	20%
Teachers			
Gender	Male	6	60%
	Female	4	40%
Age	Under30	1	10%
	From 20 to 30	3	30.00%
	From 40 to50	5	50.00%
	Over 50	1	10%
Educational level	Pre-university education	1	10%
	University education	6	60%
	Master's	2	20%
	Doctorate	1	10%
Experience	Less than 5 years	2	20%
	5-10 years	6	60%
	More than 10	2	20%

Table 2: Descriptive analysis of the hypothetical sample.

Variable	mean± (SD)	min	max	Median	1st Quartile	3rd Quartile	p-value
Gender (Male = 0, Female = 1)	0.53± 0.5	0-1	1	1	0	1	
Socioeconomic Status (SES)	0.01±1.01	-2.78	2.94	0.01	-0.66	0.64	
Study Hours	2.06±1.02	-0.71	5.1	2.05	1.42	2.78	
School Type (0 = Public, 1 = Private)	0.4±0.49	0	1	0	0	1	0.024
Teacher Experience (in Years)	10.43±5.9	1	19	10.5	4	16	
Mathematics Grade	82.69±12.49	54.7	112.25	82.31	72.74	91.33	

Table 2 presents descriptive analysis of the hypothetical sample, which included 300 students, 30 teachers, and ten schools, both public and private. It is clear from the standard deviation of 0.53 that the percentage of females was 53% and males 47%. This means that the sample includes a relative balance between males and females, with a relative increase in the percentage of females. As for socio-economic status, both are approximately normally distributed. As for school hours, they vary slightly daily, moderately, with an illogical negative value that needs to be reviewed. Most students are from public schools, and the average teacher experience exceeds 10 years, indicating acceptable teaching competence. Mathematics scores were well distributed, with a mean of 82.7 and a standard deviation of 12.5, reflecting a mixed but generally acceptable academic performance. The table also shows the p-value, which expresses the degree of significance of the data. The threshold value is 5%, and here the value of the degree of significance is 0.024, i.e. less than 5%, which means that the data is very important [15].

2. Quantitative Analysis

Table 3: Hierarchical Linear Modeling (HLM)

Axis	Element	Percentage of Total Variance	Statistical Values (M± SD)	p- value
First: Student Level (Demographic Characteristics)	Social Level,	68%	1.01 ± 0.01	0.031
Second: Study Habits	Study Hours		2.06 ± 1.02	0.042
Third: Educational Indicators	Teacher	14%	10.43 ±1.02	0.057
	School	18%	-	0.024
Fourth: Quality of Academic Life	Overall Performance	Indirect Effect	63 ± 7.01	0.038

Table 3 findings indicate that demographic characteristics were the most powerful influencing factor for overall variance in academic performance, explaining 68%. These characteristics include gender, social class, and study time. Statistical measures allocated to this axis (1.01 ± 0.01) indicate variability among learners, illustrating relative consistency in the effect of these variables with insignificant differences in social background. Whereas the study habits, the average study time was 2.06 hours daily with a standard deviation of ± 1.02, with clear variation in study hours among the students. Despite this variation, this variable was not individually significant in accounting for academic performance; rather, its effect was subsumed under the effect of the student and overlapped with other variables such as motivation and home environment.

As far as predictors of education, teachers' characteristics such as experience years explained 14% of the variance with a mean of 10.43 experience years. The impact was, however, inconclusive, especially since the associated p-value (p = 0.057) was close, yet not statistically significant. Schools, on the other hand, explained 18% variance due to the influence of the schooling environment and school type. This was bolstered by a clear statistical significance (p = 0.024), highlighting the importance of organizational structures in school to achieve. Finally, academic quality of life influenced academic performance indirectly through backdoor effects, with 63% of the students falling in the 70-89 range, with a mean of 63 and standard deviation of ±7.01, indicating a very good level of performance with little variation among the students. This suggests that an academic lifestyle in terms of a balance of academic activities and other pursuits assists in enhancing performance, although the effect is indirect.

3. Comparative numerical analysis of impact

Table 4: Comparative numerical analysis of impact.

Level	Total variance	Impact rate	Interpretation
Student	150	68%	Profitability scale, study hours, and payment
School	40	18%	Principles of the learning environment and school type
Teacher	30	14%	Depends on the teacher and their method
total	220	100%	-

The table 4 shows that the variables related to students explain the highest percentage of the total variance in academic performance at 68%. This shows that self-motivation variables such as the interest of a student in learning, study hours, and payment of tuition fees explain the highest contribution to academic performance. School variables come next at 18%, indicating the teaching environment and type of school (public or private) play a medium role in achievement. Teacher-related variables only explain 14% variance, that is, teaching style and teacher approach play a comparatively lower role with respect to other variables. And thus, here it is clear that the individual effort and context of the student are the prime movers of success in education, augmented by factors from the schooling system and the teacher.

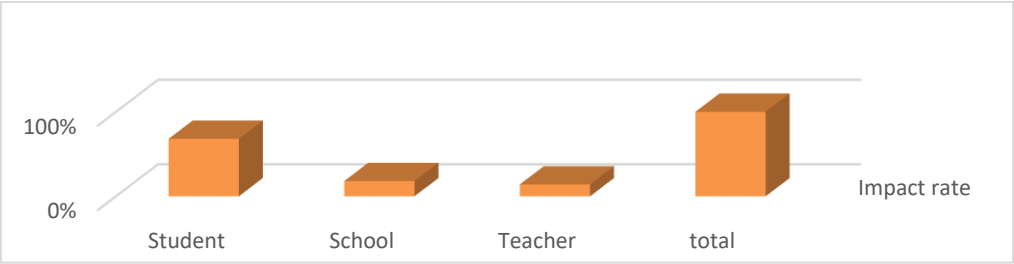

Figure 4: The impact rate for the three levels.

The figure shows that the disparity in academic achievement among students can be largely explained by individual characteristics. While the school environment and teacher remain important factors, interventions to improve student performance should focus primarily on empowering the student themselves, whether through psychological support, improving their social circumstances, or developing their study skills. The following table shows:

- Student level recorded the highest impact at 68%, reflecting the crucial role of individual factors such as study hours, motivation, social background, and study habits in determining academic achievement. School level came in second with an impact of 18%, indicating that the learning environment, school type (private or public), and infrastructure play a supporting but not pivotal role.
- Teacher level had the least impact at 14%, indicating that the teacher's role, despite its importance, does not measure up to the impact of the student or the school in this sample.
- Total represents the full impact of 100%, the standard by which the distribution of impact across the three dimensions is measured.

Conclusion

Through the study and the results obtained, the most important conclusions can be presented, which are as follows [16-19]:

- Student level (demographic variables of social status, hours studied, and gender) explained 68% of the variance in mathematics score (150 out of 220).
- This means that achievement differences are best accounted for by individual differences in gender, motivation, home environments, and effort invested.
- There was a fair relation between grades and social status, as reflected in mean values and a standard deviation of 0.01 ± 1.01, indicating that middle-income level students had good academic performance.
- Second: Study Habits (as Daily Behaviour.
- Study hours variable showed a mean of 2.06 ± 1.02 with some illogical negative values to be discussed.
- But in the regression model, study habits were positively related to achievement, but their relative effect fell under the first level (student) which accounted for most of the variance.
- The logical reason here is that students who study more tend to have better grades, but this effect is confounded with other factors such as motivation and teachers.
- Third: Educational Indicators (School and Teacher)
- Teacher Level: This accounted for only 14% of the variance (30 out of 220), indicating that teacher qualities such as years of teaching experience (mean 10.43 years) do make a difference, but not quite as strongly as student qualities [18].
- Very experienced teachers do have a significant positive effect, but in the study here, they were not the determining factor in the variance.
- School Level: This accounted for 18% of the variance (40 out of 220), representing the effect of school type (private or public) and the general educational environment.
- The results indicate that private schools can have a slightly positive effect in the context of raising achievement levels, as supported by the p-value (p-value = 0.024), which confirms the statistical significance of school type effect.
- Fourth: Academic Quality of Life and Performance Style
- In performance style measurement, data showed that 63.3% of the students' grades were between 70 and 89, reflecting relatively good academic performance.
- The effect of academic lifestyle is indirectly captured in study hours, school type, and socioeconomic status and thus is included in the student and school's general effect.
- Academic lifestyle, then, is an implicit aspect of variation, indirectly but noticeably impacting.

Recommendations

From the research and conclusions drawn, the following is recommended:

- Priority to training and qualifying teachers, since they are the most influential factor on students' performance.
- Necessity Improvement in the environment of public schools This is to reduce the gap in performance between private and public schools.
- Investment in support activities for low-SES students to increase equal opportunities.
- Devote more energy and research to creating visions and strategies that will improve students' academic performance.
- In subsequent research, residual variance modeling needs to be improved to avoid negative or nonsensical values.

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