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Optimizing Education Budget Allocation in Schools Using Excel Solver

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Abstract

Education budget management plays a crucial role in supporting the success of school education. Limited funding requires schools to allocate their budgets effectively to ensure optimal program implementation. This study aims to determine the optimal allocation of the education budget through the application of the Linear Programming method with the help of the Solver Add-in in Microsoft Excel. The study used data simulation involving four decision variables: teacher training and development budget, digital facilities and infrastructure, extracurricular activities and student welfare, and school building maintenance. An optimization model was designed based on the objective function and a number of constraints reflecting the school's budget limitations. The simulation results show that Excel Solver is capable of generating optimal budget allocation solutions within all established constraints. Therefore, Excel Solver can be used as a decision-making tool in more systematic, objective, and efficient education budget planning and management.

Keywords: Linear Programming, Excel Solver, Optimization, Educational Budget, School Management

INTRODUCTION

Education plays an important role in creating high-quality, competent human resources capable of competing in various fields. In its implementation, schools not only function as places where teaching and learning activities take place but also as institutions responsible for improving teacher competencies, providing educational facilities, fostering students' character development, and maintaining a comfortable and supportive learning environment. All of these aspects require proper budget management to ensure that educational objectives can be achieved optimally. However, the limited financial resources available to many schools often become a challenge in the budget allocation process. This condition requires the distribution of funds to be effective, efficient, and well-targeted. If budget allocation is not carried out optimally, the quality of learning may decline, educational facilities may become inadequate, and the development of school resources may not be maximized.

Along with technological advancements and the demands of 21st-century learning, schools are required to continuously adapt to various changes. The provision of digital-based facilities, enhancement of teacher capacity, support for student activities, and maintenance of school infrastructure are essential needs that must be fulfilled. On the other hand, budget limitations require schools to establish priorities in the utilization of available funds. Therefore, a decision-making method capable of producing objective and systematic solutions is needed. One method that can be applied is Linear Programming, a mathematical optimization technique aimed at obtaining the best solution while considering various existing constraints. According to Latief and Suriyanti (2023), Linear Programming is an effective method for solving various problems faced by organizations and companies, including those in the education sector. Furthermore, Lubin et al. (2022) stated that mathematical optimization models can support a more measurable and efficient decision-making process in addressing problems involving limited resources.

Various previous studies have utilized Linear Programming to optimize goods distribution, transportation systems, operational cost management, and resource allocation. In the education sector, several studies have also demonstrated that optimization approaches can improve the efficiency of educational facilities and resource utilization (Oladejo et al., 2025). Nevertheless, the application of Linear Programming using Excel Solver for optimizing school budget allocation remains relatively limited, particularly in managing funds that consider a balance among teacher development, digital facility provision, student welfare, and school building maintenance. Therefore, this study was conducted to offer a more objective and measurable alternative for decision-making in educational budget management.

This study employs four main decision variables: the budget for teacher training and professional development (x_1), the budget for digital facilities and infrastructure (x_2), the budget for extracurricular activities and student welfare (x_3), and the budget for building maintenance (x_4). These four variables were selected because they significantly influence the improvement of educational quality within schools.

In this study, educational quality is represented by the Educational Quality Index (Z). This index serves as an indicator of the effectiveness of budget allocation in supporting educational quality improvement. Since this research uses simulated data, each variable is assigned a different contribution weight. Teacher training and professional development is assigned a weight of 30, digital facilities and infrastructure a weight of 35, extracurricular activities and student welfare a weight of 20, and building maintenance a weight of 15. These weights reflect the contribution level of each program to educational quality within the optimization model used. The optimization model in this study aims to maximize the Educational Quality Index (Z), formulated as follows:

$\text{Max } Z = 30x_1 + 35x_2 + 20x_3 + 15x_4$

Subject to the total school budget constraint of IDR 500,000,000, formulated as follows:

$x_1 + x_2 + x_3 + x_4 \leq 500$

As well as the minimum and maximum limits for each decision variable:

$100 \leq x_1 \leq 150$

$120 \leq x_2 \leq 170$

$80 \leq x_3 \leq 110$

$50 \leq x_4 \leq 70$

All decision variables must be non-negative:

$x_1, x_2, x_3, x_4 \geq 0$

To obtain the optimal solution, this study utilizes the Solver Add-ins feature in Microsoft Excel. The selection of Solver is based on its ease of use, the absence of a requirement for complex additional software, and its capability to support quick and systematic decision-making processes (Maryana et al., n.d.). Moreover, Excel Solver is considered practical and easy to implement by schools for simulating educational budget allocations. Therefore, this study aims to determine the optimal allocation of school budgets using the Linear Programming Simplex method based on Excel Solver, so that educational quality can be maximized despite limited available resources.

METHOD

This study applies the Linear Programming method using the Simplex approach to determine the most optimal allocation of school budgets in an effort to improve educational quality. Linear Programming is a mathematical optimization method used to obtain the best solution to a problem based on an objective function and a set of constraints that must be satisfied. Data processing was conducted using the Solver Add-ins feature in Microsoft Excel because it is easy to operate, does not require complex additional software, and is capable of generating optimization solutions effectively and systematically. Winston and Albright (2019) stated that Microsoft Excel Solver is one of the most widely used tools for solving optimization and decision-making problems based on mathematical models.

The research was carried out through several stages. The first stage involved identifying problems related to school budget allocation, including teacher development, provision of digital facilities, student welfare, and school building maintenance. The second stage consisted of a literature review on the application of Linear Programming and the use of Excel Solver in optimization processes. The next stage was the formulation of decision variables, the objective function, and research constraints. Subsequently, the model was simulated using Solver in Microsoft Excel. The final stage involved analyzing the optimization results to obtain alternative budget allocations that provide the best outcomes for improving educational quality.

This study uses four decision variables, namely:

x_1 = Budget for teacher training and professional development

x_2 = Budget for digital facilities and infrastructure

x_3 = Budget for extracurricular activities and student welfare

x_4 = Budget for school building maintenance

Educational quality in this study is represented by the Educational Quality Index (Z). Since simulated data are used, each program is assigned a different contribution weight according to its level of influence on improving educational quality. Teacher training and professional development are assigned a weight of 30, digital facilities and infrastructure a weight of 35, extracurricular activities and student welfare a weight of 20, and building maintenance a weight of 15. Based on these assumptions, the objective function is formulated to maximize the value of the Educational Quality Index as follows:

$\text{Max } Z = 30x_1 + 35x_2 + 20x_3 + 15x_4$

Where:

Z = Educational Quality Index

x_1 = Budget for teacher training and professional development

x_2 = Budget for digital facilities and infrastructure

x_3 = Budget for extracurricular activities and student welfare

x_4 = Budget for school building maintenance

The total budget available in this study is IDR 500,000,000, which serves as the primary constraint in the optimization process. The budget constraint is expressed as follows:

$x_1 + x_2 + x_3 + x_4 \leq 500$

In addition, each decision variable has minimum and maximum limits adjusted to the operational needs of the school, namely:

$100 \leq x_1 \leq 150$
$120 \leq x_2 \leq 170$
$80 \leq x_3 \leq 110$
$50 \leq x_4 \leq 70$
All decision variables must also satisfy the non-negativity requirement:
$x_1, x_2, x_3, x_4 \geq 0$
The model was implemented using Solver in Microsoft Excel with the Simplex LP solving method. The objective function on the Excel worksheet was calculated using the formula:
$= \text{SUMPRODUCT}(B2{:}B5, C2{:}C5)$
Meanwhile, the total budget utilization was calculated using the formula:
$= \text{SUM}(B2{:}B5)$

The next step was to define the Set Objective in the objective function cell, specify the By Changing Variable Cells for the decision variables, and enter all research constraints into the Solver Parameters. After all parameters had been established, the optimization process was executed using the Simplex LP method to obtain the most optimal budget allocation solution.

RESULT

a. Mathematical Model

This study applies the Linear Programming method to obtain the most optimal allocation of educational budgets within a school environment. The optimization model consists of four decision variables, namely the budget for teacher training and professional development (x_1), the budget for digital facilities and infrastructure (x_2), the budget for extracurricular activities and student welfare (x_3), and the budget for school building maintenance (x_4). The primary objective of this model is to maximize the value of the objective function, which represents the quality of budget allocation based on the contribution level of each variable to educational budget management. The mathematical model used in this study is formulated as follows:
$\text{Max } Z = 30x_1 + 35x_2 + 20x_3 + 15x_4$
Subject to the following constraints:
$x_1 + x_2 + x_3 + x_4 \leq 500$
$100 \leq x_1 \leq 150$
$120 \leq x_2 \leq 170$
$80 \leq x_3 \leq 110$
$50 \leq x_4 \leq 70$
$x_1, x_2, x_3, x_4 \geq 0$

b. Variables and Contribution Scores

Table 1. Variables and Contribution Scores of the Objective Function

Variable	Description	Contribution Score
x_1	Teacher Training and Professional Development	30
x_2	Digital Facilities and Infrastructure	35
x_3	Extracurricular Activities and Student Welfare	20
x_4	Building Maintenance	15

c. Model Implementation in Microsoft Excel

After the mathematical model was formulated, the next stage was to implement the model in Microsoft Excel. The data used in this process included the decision variables, the contribution scores of each variable, the minimum and maximum limits for each variable, and the total available budget as the primary constraint in the optimization process.

B17

	A	B	C	D	E
1	VARIABLE	VALUE	ONTRIBUTION SCOR	MINIMUM	MAXIMUM
2	Teacher Training & Development Budget (X1)	150	30	100	150
3	Digital Infrastructure & Facilities Budget (X2)	170	35	120	170
4	Extracurricular & Student Welfare (X3)	110	20	80	110
5	Maintenance & Building Budget (X4)	70	15	50	70
6					
7					
8					
9	Max Z	13700			
10	Total Budget	500			
11					
12					

Fig 1. Input Variable Data and Budget Constraints Using Excel Solver

The data served as the basis for the optimization process using Excel Solver.

d. Objective Function Calculation

In this study, the value of the objective function was calculated using the **SUMPRODUCT** function, which multiplies each decision variable by its corresponding contribution score and then sums all the resulting products. Meanwhile, the total budget utilized was obtained using the **SUM** function by adding all decision variable values. All calculations were performed automatically in Microsoft Excel before the optimization process was executed.

Formulas:

=SUMPRODUCT(B2,C2)

=SUM(B2)

B9 =SUMPRODUCT(B2:B5;C2:C5)

	A	B	C	D	E
1	VARIABLE	VALUE	ONTRIBUTION SCOR	MINIMUM	MAXIMUM
2	Teacher Training & Development Budget (X1)	150	30	100	150
3	Digital Infrastructure & Facilities Budget (X2)	170	35	120	170
4	Extracurricular & Student Welfare (X3)	110	20	80	110
5	Maintenance & Building Budget (X4)	70	15	50	70
6					
7					
8					
9	Max Z	13700			
10	Total Budget	500			
11					
12					

Fig 2. Budget Objective Function Calculation Using Excel Solver

B10 =SUM(B2:B5)

	A	B	C	D	E
1	VARIABLE	VALUE	ONTRIBUTION SCOR	MINIMUM	MAXIMUM
2	Teacher Training & Development Budget (X1)	150	30	100	150
3	Digital Infrastructure & Facilities Budget (X2)	170	35	120	170
4	Extracurricular & Student Welfare (X3)	110	20	80	110
5	Maintenance & Building Budget (X4)	70	15	50	70
6					
7					
8					
9	Max Z	13700			
10	Total Budget	500			
11					
12					

Fig 3. Total Budget Calculation Using Excel Solver

e. Solver Configuration

The next stage involved configuring the Solver tool. At this stage, the objective function cell (**Set Objective**), the cells containing the decision variables (**By Changing Variable Cells**), and all constraints used in the research model were specified. The optimization process was then executed using the **Simplex LP** method, as the formulated model belongs to the category of **Linear Programming**.

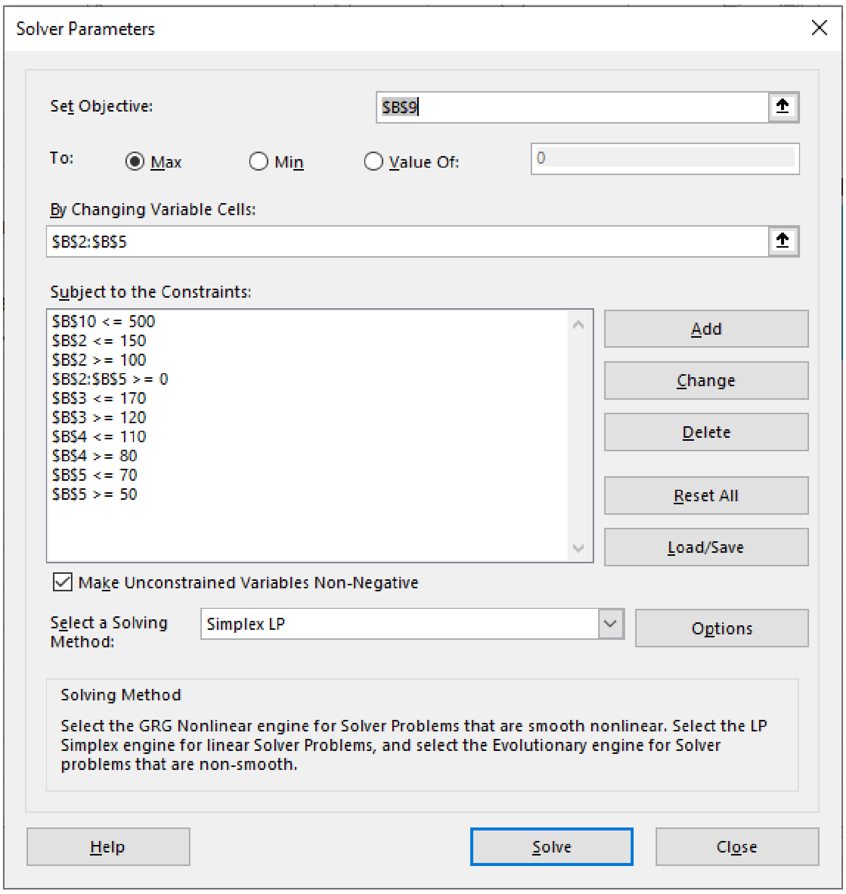

Fig 4. Setting Constraints and Parameters Using Excel Solver

f. Optimization Results

After all parameters had been successfully entered into Solver, the optimization process was executed to obtain the most optimal solution in accordance with the objective function and all predetermined constraints. The optimization results produced optimal values for each decision variable while satisfying all limitations and requirements specified in the research model.

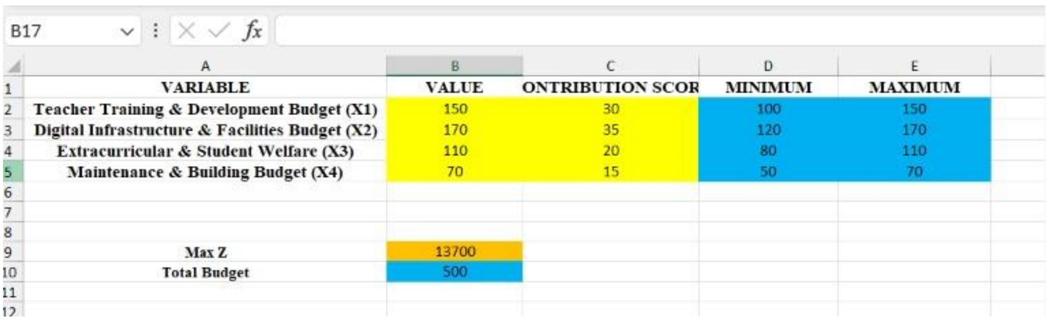

Fig 5. Optimization Results Using Excel Solver

Based on the optimization results obtained using Excel Solver, optimal values were determined for each decision variable. All variables satisfied the specified minimum and maximum limits, and the total budget allocation did not exceed the available budget constraint.

Table 2. Optimization Results of Educational Budget Allocation

Variable	Optimal Value (Million Rupiah)
X_1	150

x_2	170
x_3	110
x_4	1570

g. Objective Function Value

The objective function value was obtained through the following calculation:

Z = 30(150) + 35(170) + 20(110) + 15(70)

Z = 4,500 + 5,950 + 2,200 + 1,050

Z = 13,700

Based on the optimization results obtained using Solver in Microsoft Excel, the maximum objective function value achieved was **13,700**, with a total budget allocation of **IDR 500,000,000**. All decision variables were within the predetermined minimum and maximum limits; therefore, the resulting solution can be considered optimal and compliant with all requirements specified in the research model.

DISCUSSION

a. Interpretation of the Optimization Results

The optimization results indicate that the Linear Programming method is capable of generating an optimal budget allocation while satisfying all constraints specified in the model. Based on the simulation results, an allocation of IDR 150,000,000 was assigned to teacher training and professional development programs, IDR 170,000,000 to digital facilities and infrastructure, IDR 110,000,000 to extracurricular activities and student welfare, and IDR 70,000,000 to school building maintenance. The maximum objective function value of 13,700 indicates that this combination of allocations represents the best solution that can be obtained based on the optimization model employed. These results suggest that all budget components contribute positively to the objective value, resulting in each variable receiving an allocation at its allowable maximum limit.

b. Constraint Analysis

In the Linear Programming model, constraints function as boundaries that ensure the resulting solution remains realistic and applicable in real-world conditions. In this study, the primary constraint of a total budget of IDR 500,000,000 was successfully satisfied. Furthermore, each decision variable remained within its predetermined minimum and maximum limits. This demonstrates that the obtained solution does not exceed budgetary limitations or the operational requirements of the school. Therefore, the optimization results can be considered feasible and suitable as a basis for decision-making in educational budget management.

c. Budget Utilization Efficiency

Based on the optimization results, all available funds were utilized to their maximum extent without leaving any unallocated budget. The total allocated funds amounted to IDR 500,000,000, which is equal to the total available budget. This condition indicates that neither budget waste nor underutilization occurred. From an educational management perspective, these findings reflect efficient use of financial resources. Through the optimization approach, each program received funding according to the requirements established in the model, making the budgeting process more focused, systematic, and measurable compared to conventional methods.

d. Comparison with Non-Optimized Budget Allocation

If the budget allocation process is carried out without the use of optimization methods, funding decisions generally depend more heavily on the subjective judgment of school administrators. Such a situation may lead to an imbalance in budget distribution among programs, such as excessive funding for one particular program and insufficient allocation for others. In contrast, the application of Linear Programming enables a more objective decision-making process because all decisions are based on the objective function and constraints formulated within the mathematical model. Consequently, the resulting allocation is more logical, transparent, and accountable.

e. Relationship to Previous Studies

The findings of this study are consistent with those of Indra Purnama et al. (2021), who stated that Excel Solver can be utilized as a decision-support tool for effectively solving various optimization problems. Furthermore, the results support the argument of Ginting (2012), who explained that the Linear Programming method is capable of producing optimal solutions in situations involving limited resources. The primary difference between this study and previous research lies in its object of analysis, namely the optimization of educational budget allocation within a school environment. Therefore, this study provides additional empirical evidence regarding the application of Linear Programming in the education sector, where it has traditionally been applied more extensively in industrial and business contexts.

f. Implications for School Budget Management

The results of this study have important practical implications for school budget management. The utilization of Excel Solver can assist schools in preparing budget plans in a more systematic, objective, and data-driven manner. In addition, this method facilitates decision-makers in determining funding priorities while considering existing resource limitations. The implementation of budget optimization also has the potential to enhance transparency and accountability in school financial management, as each allocation decision is based on a clearly defined mathematical model. Therefore, Excel Solver can serve as a practical, cost-effective, and easily implementable alternative to support more effective and efficient educational budget planning processes.

CONCLUSION

Based on the results of the study, the Linear Programming method implemented through the Solver Add-ins feature in Microsoft Excel was proven to be capable of generating an optimal educational budget allocation while satisfying all constraints specified in the model. The optimization results indicate that allocating IDR 150,000,000 for teacher training and professional development, IDR 170,000,000 for digital facilities and infrastructure, IDR 110,000,000 for extracurricular activities and student welfare, and IDR 70,000,000 for school building maintenance represents the best solution that fulfills all research constraints. These findings suggest that Excel Solver can be utilized as a decision-support tool for managing educational budgets in a more structured, objective, and efficient manner. Nevertheless, this study was conducted using simulated data and involved only four decision variables. Therefore, future research is recommended to employ actual school data and incorporate a wider range of variables in order to obtain more representative and comprehensive results.

REFERENCES

Indra Purnama, P., Sipil, T., Teknik, F., Dan, S., & Indonesia, U. I. (2021). *MENGGUNAKAN PROGRAM LINIER METODE SIMPLEX DAN BUILDING INFORMATION MODELING (BIM) (OPTIMIZATION BEAM REINFORCEMENT USING LINEAR PROGRAM SIMPLEX METHOD AND BUILDING INFORMATION MODELING) MENGGUNAKAN PROGRAM LINIER METODE SIMPLEX DAN BUILDING INFORMATIO*.

Latief, F., & Suriyanti, D. (2023). *Economics and Digital Business Review Analisis Perencanaan Produksi Dengan Metode Linear Programming Guna Memaksimalkan Keuntungan*. *4*(1), 383–397.

Lubin et al. (2022). (n.d.). *JuMP 1.0: Recent improvements to a modeling language for mathematical optimization*.

Maryana, M., Putri, I. H., Sepriadi, S., Studi, P., Pertambangan, T., Palembang, P. A., Simpleks, M., & Solver, M. E. (n.d.). *PENERAPAN METODE SIMPLEKS DENGAN MICROSOFT EXCEL SOLVER UNTUK OPTIMALISASI BLENDING BATUBARA SESUAI KRITERIA*. *8*, 614–621.

Oladejo, N. K., Abdul-shakuru, M., & Jafar, A. W. (2025). *Linear Programming Techniques and Its Application in Optimizing Lecture Room in an Institution*. *14*(1), 10–28. https://doi.org/10.4236/ojop.2025.141002

Fakhriyana, D., & Anggreini, M. N. (2026). *Simplex vs. Revised Simplex for Budget Allocation in Madrasah Teacher and Staff Development Programs under MoRA Kudus, Indonesia*. Zero: Jurnal Sains, Matematika, dan Terapan.

Santi, E. E. (2015). *Pemanfaatan Solver Excel untuk Optimasi Penjadwalan Mata Pelajaran*. Jurnal Dimensi Pendidikan dan Pembelajaran, 3(1), 9–15.

Anam, M. S. (2024). *Pemanfaatan Solver Excel untuk Menentukan Mahasiswa Penerima Beasiswa Menggunakan Pemrograman Linier*. EPIC Journal.

Maryana, M., Putri, I. H., Sepriadi, S., et al. (2024). *Penerapan Metode Simpleks dengan Microsoft Excel Solver untuk Optimalisasi Blending Batubara Sesuai Kriteria*. Jurnal Teknik Pertambangan, 8, 614–621.

Celestin, M., Kumar, M. S., Gidisu, J. A., & Dometi, W. T. (2025). *The Utilization of Advanced Linear Programming Models to Optimize Allocation of Limited Public Resources in the Context of Public Financial Management Systems*. Kings and Queens Journal of Multidisciplinary Research, 1(1), 49–60.

Wan Abdul Aziz, R. et al. (2019). *Dynamic Linear Programming Model for Quarterly Budget Allocation and Execution*. Universiti Teknologi MARA

Maktabi, H., Tohidi, H., & Seyedaliakbar, S. M. (2011). *An Application of Linear Programming for Efficient Resource Allocation: Case Study of University Education*. Australian Journal of Basic and Applied Sciences, 5(12), 703–706.

Hudawi, A. (2025). *Enhancing Internship Assignment Efficiency Through Spreadsheet-Based Linear Programming Using Microsoft Excel Solver*. Journal of Knowledge Optimization and Innovation.

Samsuriah. (2020). *Metode Simpleks dalam Program Linear dengan Fungsi Solver di Excel*. Progres: Professional Journal in Integrity, Knowledge, and Skill, 12(1), 2–7.