Published online on the page : https://ejournal.uinbukittinggi.ac.id/index.php/ijokid/

Knowbase : International Journal of Knowledge in Database

| ISSN (Print) 2798-0758 | ISSN (Online) 2797-7501 |

Design of a Decision Support System to Determine Scholarship Recipients at SMKN 2 Padang Panjang

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Article Information

Article History:

Submitted:April 29, 2025
Revision: May 15, 2025
Accepted: June 11, 2025
Published: June 30, 2025

Keywords

Design
Decision Support System
Analitycal Hierachy Process
Agile Development Model
Scholarship Recipients

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A B S T R A C T

This research is based on field findings through observations and interviews at SMKN 2 Padang Panjang, which revealed that the process of managing school fee relief scholarship acceptance data is still done manually. This condition causes slow data input processes, slows down administration, and increases the potential for errors in processing student data. Thus, the main focus of this research is to create a valid, practical and effective SPK design in determining scholarship acceptance. This research is a type of Research and Development (R&D) research, using the Analytical Hierarchy Process (AHP) method and the Agile development model. Based on the results of the validity test with 3 lecturers, the system obtained a score of 0.86, indicating a very high level of validity. The practicality test with 3 teachers obtained a score of 0.97, indicating that the system is easy to use. Meanwhile, the results of the effectiveness test with 22 students obtained a score of 0.87, indicating that this system is effective in supporting the scholarship recipient selection process. Unlike previous studies that generally only apply one decision-making method or use conventional development models, this study integrates AHP with an Agile approach to produce a system that is more accurate, practical, and adaptive to school needs. With these achievements, the developed decision support system is worthy of being used as a reliable and efficient tool in determining scholarship recipients at SMKN 2 Padang Panjang.

1. Introduction

Technological advances and open access to information in the modern era have influenced various aspects of life. Efforts to improve the quality of human resources are fundamental to achieving national development goals. One strategic step in achieving this is through education, which is the collective responsibility of all Indonesian people[1]. Education is a process that is deliberately designed with the aim of supporting students in exploring and improving their potential, both physically and spiritually, through direction and guidance[2]. The role of the teacher in this process is very crucial, because through their guidance it is hoped that students can grow, develop, and be able to achieve their life goals independently and sustainably[3]. Education has a

very big influence on human life. With education, individuals can develop the skills, knowledge and insight needed to face challenges in the modern world[4].One way to access quality education is through scholarships. Scholarships are not only intended for those experiencing financial difficulties, but also encourage high-achieving students to continue developing. With scholarships, the dream of continuing higher education can become easier to achieve, opening the door to a brighter and more competitive future[5]. The scholarship program is the same as charity which has terms and conditions for obtaining it. These terms and conditions refer to regulations that have been officially established by the government, which clearly state that students are entitled to receive a scholarship if they have outstanding academic or non-academic achievements, but are hampered by economic limitations because their parents' economic conditions are not sufficient to finance their education[6]. Not only that, the law also emphasizes that students from disadvantaged families still have the right to receive educational funding, regardless of achievement, to ensure that the right to education remains guaranteed and is not interrupted due to financial difficulties[7]. This program is held to ensure that every citizen, regardless of their economic condition, gets a fair opportunity to access quality education. In addition, the scholarship program also aims to encourage students' enthusiasm for learning so that they continue to excel and help ease the economic burden on families, while creating equal opportunities in achieving their dreams. In its implementation, this scholarship program is often accompanied by a strict selection process, including document verification, achievement assessment, and analysis of the economic conditions of the recipient's family, so that the assistance can be distributed to those who really need it [8].

The rapid advancement of digital technology has brought significant changes to various areas of human life, leaving a strong impact, both positive and negative. In the world of education, this technology opens wider access to various information and learning materials, enabling students to learn independently and flexibly[9]. One of the most visible benefits is the ease of obtaining information about scholarship programs. Currently, many educational institutions, government agencies, and private institutions utilize digital media to disseminate information about the requirements, criteria, and procedures for applying for scholarships[10]. Through the internet, students from various regions, including remote areas, can easily find scholarship opportunities that match their potential and personal interests. In addition, the scholarship application process can now be done online, thus supporting efficiency, simplifying selection, and increasing transparency in the admissions process[11].

This finding was obtained through an interview session conducted by the author on August 8, 2024, at 11:00 WIB with Mrs. Fitra Gustina, S.Pd., the author discovered a number of obstacles faced by schools in the scholarship application process. The high number of scholarship requests, both from the Smart Indonesia (PIP) program, Rajawali Grants, Baznas, and requests for tuition relief, resulted in a pileup of application files in the administration room. This condition has an impact on the slowness of the data input process which is still manual, thus slowing down the administrative process and being prone to errors [12].

The school tuition relief scholarship program is a scholarship program at SMKN 2 Padang Panjang, in the form of a reduction or cut in school fees paid monthly by students. There are four categories of reductions given in the tuition relief scholarship program, namely the 25% 50% 75% to 100% category with certain criteria that have been determined by the school. The manual implementation process is one of the main obstacles in inputting data for prospective recipients of the school tuition relief scholarship. In each input stage, teachers need quite a lot of time to enter data one by one, which of course requires high accuracy. If teachers are given limited time to complete this task, the possibility of data input errors becomes very large. These errors can have fatal consequences, such as entering inaccurate data, incorrectly determining scholarship recipients, or even eliminating data on students who should receive assistance. This not only slows down the scholarship awarding process but can also be detrimental to students who are very dependent on the assistance.

Several previous studies have developed decision support systems for scholarship recipients using Multi-Criteria Decision-Making (MCDM) methods such as Simple Additive Weighting (SAW), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and Analytic Hierarchy Process (AHP). These systems

assist in recommending scholarship recipients based on specific criteria such as academic achievement, economic conditions, and family background. However, most of these studies are limited to calculation simulations, not yet integrated into school administration systems, or not yet adapted to the scholarship policy model of reduced school fees.

Based on these conditions, this study proposes the development of a web-based information system for selecting school tuition relief scholarships using the CodeIgniter 4 framework, integrating the AHP method for criteria weighting and Agile as a system development model. This system not only simplifies the calculation and ranking process but also produces outputs tailored to school needs, namely tuition reduction categories of 25%, 50%, 75%, and up to 100%. With this system, the selection process is expected to be more efficient, transparent, and targeted, while also being novel compared to previous research, which was generally limited to simulation aspects without direct implementation in the school environment..

2. Method

This research is a type of Research and Development (R&D) research, namely research that aims to produce a certain product while testing the effectiveness of the product. In its implementation, this research uses the Analytical Hierarchy Process (AHP) method as an approach in decision making that involves many criteria [13]. The AHP method was chosen because it is able to provide a systematic assessment through structured weighting of criteria and sub-criteria, so that the results of the decisions obtained are more objective, rational, and can be scientifically accounted for. In the system development process, this research adopts the Agile development model [14].

2.1. System Development Model

In this study, the author uses the System Development Life Cycle (SDLC) model using the Agile development method. Agile system development methods or Agile Development Methods are a set of software development models based on similar principles or short-term system development that requires developers' ability to adapt quickly to various changes. The Agile development method is one type of methodology applied in the software development process [15].

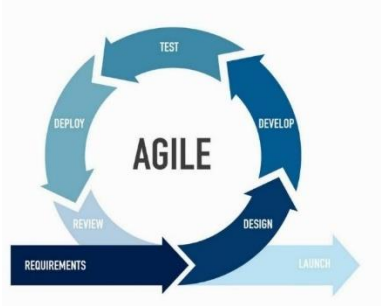


Figure 1. Model *Agile Development*

2.2. Research Stages

2.3.1 *Requirements*

Requirements is the process of collecting, analyzing, and managing user and stakeholder needs, which will form the primary basis for product or system development. This stage is a crucial step in which user needs and system requirements are identified, analyzed, and clearly documented so that they can be understood by all parties involved. At this stage, information is typically gathered through observation, interviews, or other relevant methods to obtain a comprehensive picture of the existing problem. This information is then analyzed in-depth to determine appropriate, realistic solutions that align with the objectives desired in product development [16].

2.3.2 *Design*

Design is the process of creating a technical solution and user interface plan that aims to meet the needs identified in the previous stage. This stage produces a clear blueprint or plan for how the system will be built, including technical specifications, system architecture, workflow, and visual user interface design. The design stage provides developers with a structured guide so that the implementation process can be more focused, consistent, and in line with user needs and system objectives [17].

2.3.3 *Develop*

Development is the stage where the system is built and realized based on a previously created design. At this stage, the main activities include writing program code, developing and managing databases, and integrating various system components so that they can function as a whole. The development process usually uses various programming languages, frameworks, and development tools according to the needs of the designed system. This stage is very important because the results of the development will be a tangible manifestation of the specifications and designs that have been determined, so the quality of the code, database structure, and integration between modules must be carried out carefully so that the system can function according to its objectives [18].

2.3.4 *Test*

Testing is the stage where the developed system is thoroughly tested to ensure that the system functions properly, is stable, and is able to meet all predetermined requirements. The testing process can include various types, such as unit testing to check individual sections of code, integration testing to ensure components work together correctly, system testing to assess overall performance, and user acceptance testing which involves direct assessments from end users. This stage aims primarily to find, analyze, and fix bugs or problems that arise, so that the quality of the system can be guaranteed before it is launched and used for real[19].

2.3.5 *Deploy*

Deployment is the stage where a system that has been tested and approved is launched into a production environment so that it can be used by real users. This process usually involves a series of important activities, such as software installation, system configuration, data migration if necessary, and user training to operate the system properly. At this stage, it is necessary to ensure that all technical, operational, and security aspects run smoothly so that the system can function optimally. Deployment is also a crucial moment because it determines the success of the system implementation in supporting user needs according to the designed objectives [20].

2.3.6 *Review*

Review is an important process carried out to evaluate work results, obtain feedback, and make necessary adjustments so that the quality of the product and the development process can be continuously improved. This stage not only serves as a means of assessment to ensure whether the system being built truly meets the goals, needs, and requirements that have been set from the beginning, but also as a control mechanism to identify deficiencies, errors, or potential problems that may arise. With the review, improvements can be made early so that the system being developed is more guaranteed in quality before it is finally fully used by users[21].

2.3.6 *Launch*

Launch is the process by which a developed system is introduced and begins to be used by users. This stage is not limited to the launch, but also includes preparatory activities such as installation, configuration, socialization, and user training to ensure proper system utilization. Launch is a crucial moment because at this stage the system is tested in a real user environment to ensure functionality, ease of use, and compliance with established needs[22]

3. Results and Discussion

3.1. Resultts

This stage is the stage for the author in describing the processes carried out in creating a product. This stage is in accordance with the AGILE type system development model with the processes namely Requirements, Design, Develop, Test, Deploy, Review, and Launch[23].

3.1.1. Reuquirements

Before designing a scholarship acceptance decision-making system at SMKN 2 Padang Panjang, the author conducted observations and interviews with guidance counselors, administrators, and students to understand the criteria and problems of the previous manual selection process, which were unclear, subjective, and time-consuming because the data was summarized through Excel. The new system involves admins (guidance counselors/principals) and users (students), where guidance counselors can monitor and manage files in real-time, while students gain transparency and ease of data input. System requirements include data management, analysis, and access to scholarship information, as well as non-functional support in the form of hardware (at least a 4GB laptop/smartphone), software (Windows 11, PHP, MySQL, XAMPP, browser, VS Code), and human resources (guidance counselors) capable of operating web applications and managing data and analyzing results [24].

3.1.2. Design

In this design stage, the author will design a website that meets the needs and will assist in the decision-making process for scholarship acceptance at SMKN 2 Padang Panjang. The design of this system includes a use case diagram, input form, report, and database, as follows.

In this section, the researcher will explain the system functions as well as the input and output interfaces of the decision support system in determining scholarship recipients. Users in the system are admin and user [25]. The guidance counselor acts as admin and students as users, who have various roles and functions. The guidance counselor can access the website, edit and process files, delete data, and download scholarship results, while students can access the main page of the website and input scholarship files [26].

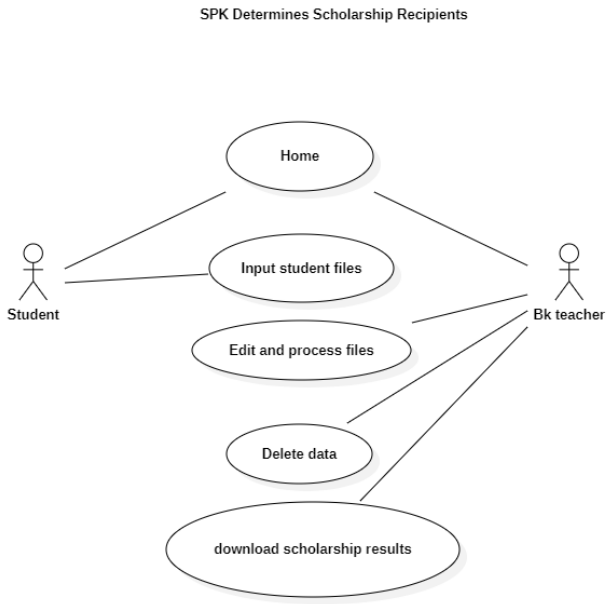


Figure 2. Use Case Diagram

Input design is a display design used to enter supporting data into the system. Data entered through this input will be processed and produce output in the form of information that can be understood by the user[27].

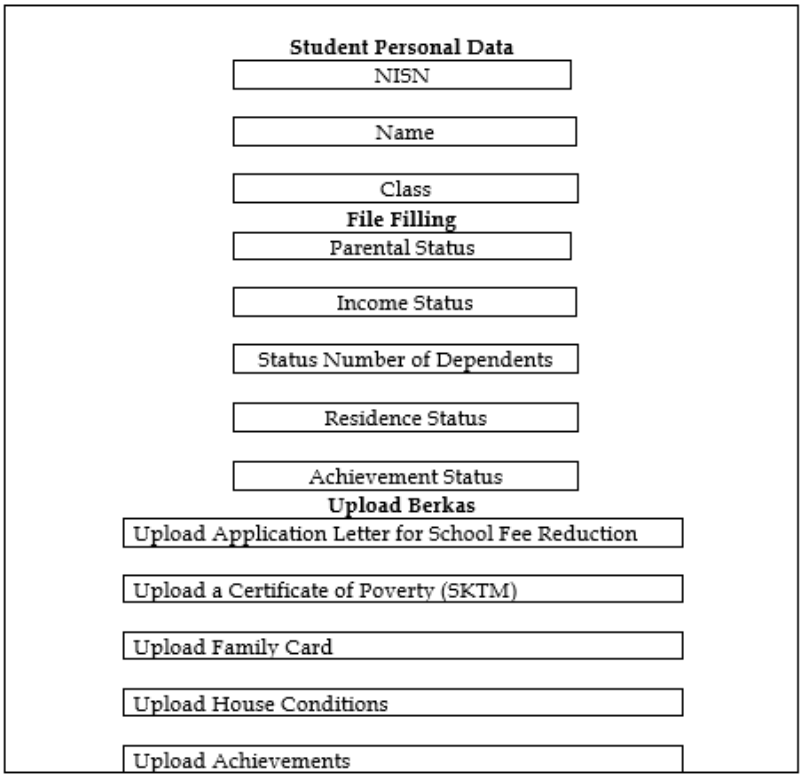


Figure 3. Form input

SCHOLARSHIP RECIPIENTS OF SMKN 2 PADANG PANJANG 2025

No: 421/SCH/SMKN2/PP/2025

No	NISN	Name	Class	File	Reduction of Fees

Padang Panjang,28-05-2025
Headmaster

Nasrial,S.Pd
Nip:19707261992031005

Figurer 4. Scholarship acceptance report

dbscholarship **tbstudentfiles**
nisn : int(20)
name : varchar(50)
class : varchar(5)
parents : varchar(20)
income : varchar(30)
number_dependents : varchar(20)
residence : varchar(20)
achiements : varchar(100)
aplication_letter : varchar(100)
sktm : varchar(100)
family_card : varchar(100)
house_condition : varchar(100)
certificate : varchar(100)
ahp_results : varchar(5)
ahp_score : varchar(10)

Figure 5. Database

3.1.3. Develop

This stage is the stage of translating the system design into a programming language, in which case the author uses the PHPMySQL programming language with the Codeigniter Framework as a framework to be more efficient in building a system, the system design is as follows[28]:

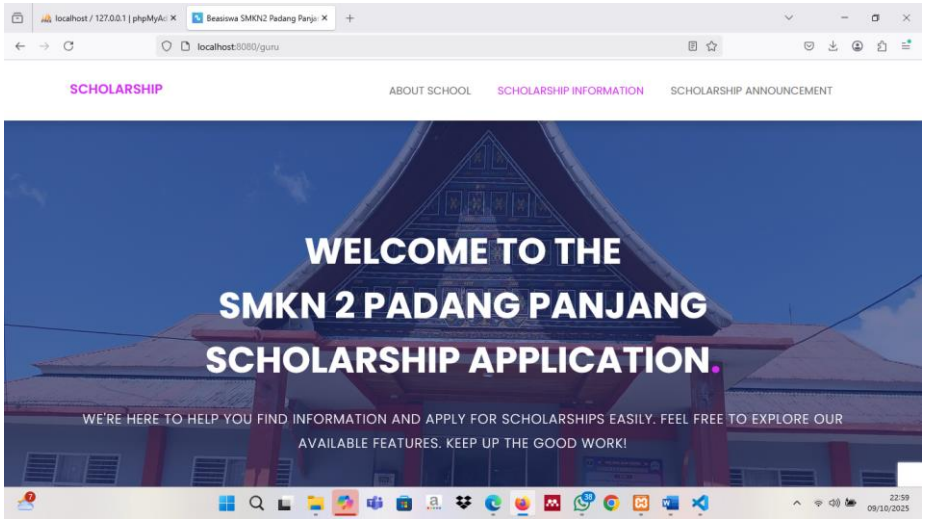


Figure 6. Home view

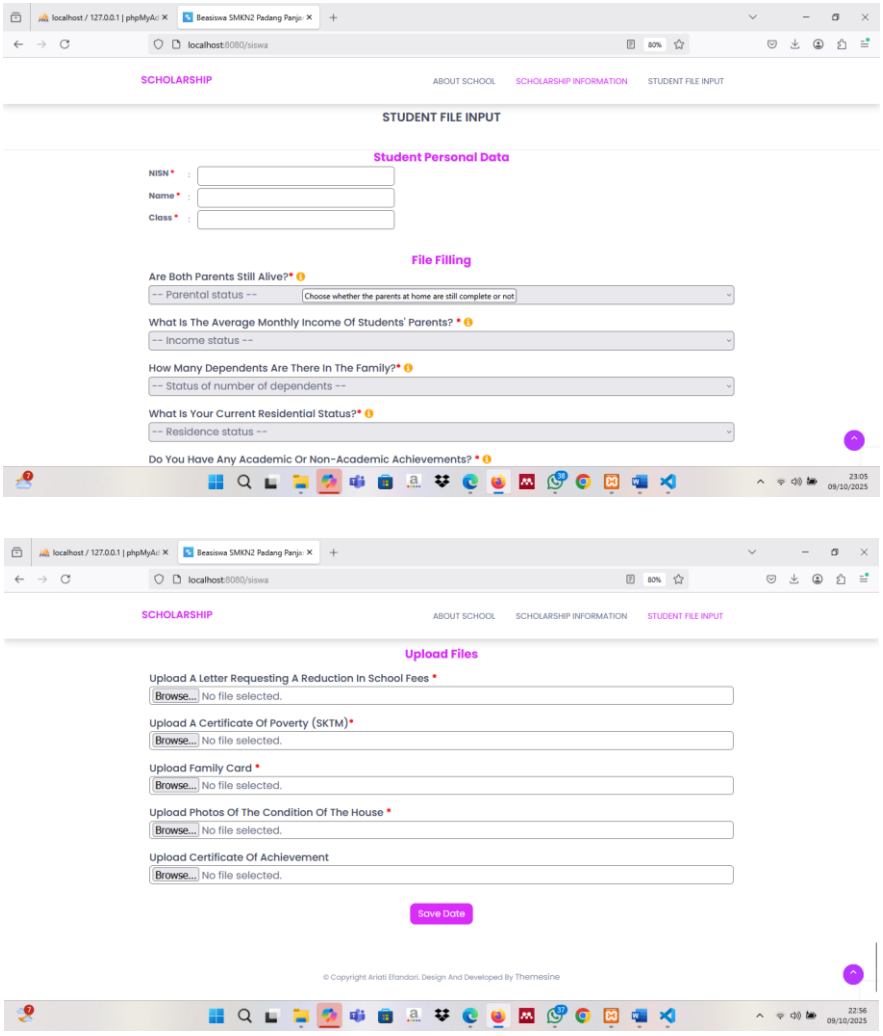


Figure 7. Form input

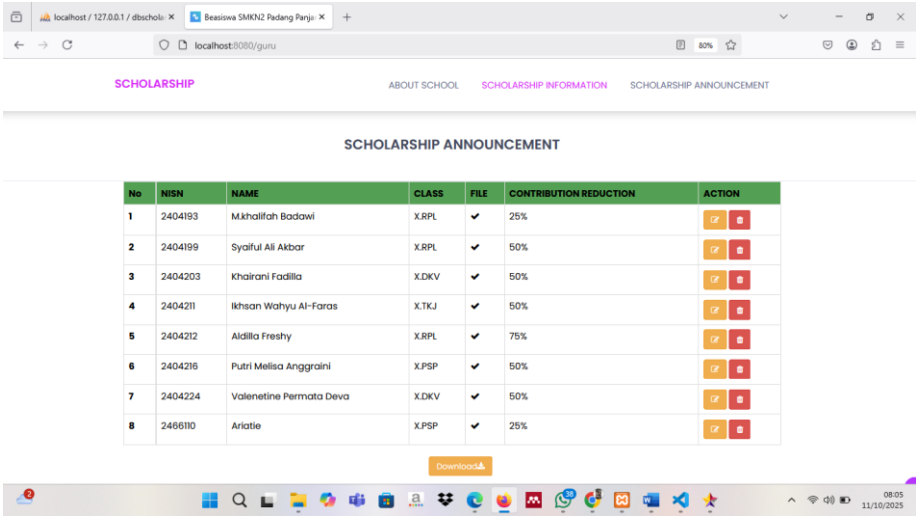
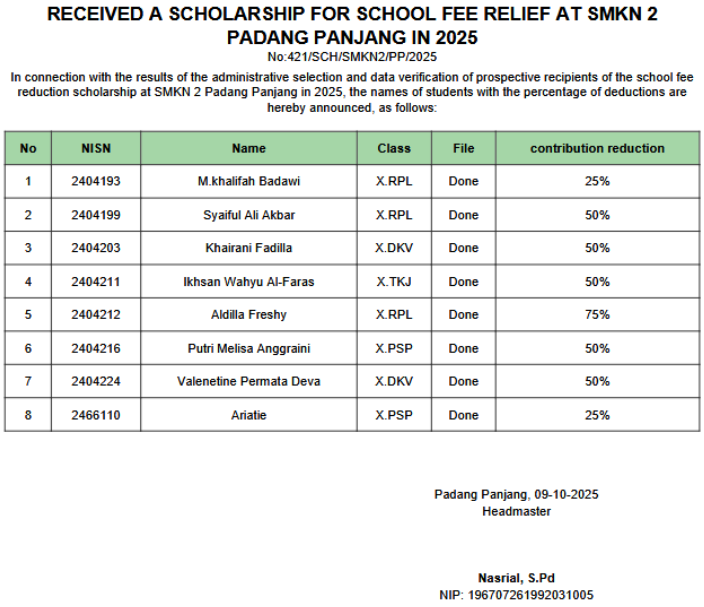


Figure 8. Scholarship announcement



RECEIVED A SCHOLARSHIP FOR SCHOOL FEE RELIEF AT SMKN 2 PADANG PANJANG IN 2025

No:421/SCH/SMKN2/PP/2025

In connection with the results of the administrative selection and data verification of prospective recipients of the school fee reduction scholarship at SMKN 2 Padang Panjang in 2025, the names of students with the percentage of deductions are hereby announced, as follows:

No	NISN	Name	Class	File	contribution reduction
1	2404193	M.khalifah Badawi	X.RPL	Done	25%
2	2404199	Syaiful Ali Akbar	X.RPL	Done	50%
3	2404203	Khairani Fadilla	X.DKV	Done	50%
4	2404211	Ikhsan Wahyu Al-Faras	X.TKJ	Done	50%
5	2404212	Aldilla Freshy	X.RPL	Done	75%
6	2404216	Putri Melisa Anggraini	X.PSP	Done	50%
7	2404224	Valenetine Permata Deva	X.DKV	Done	50%
8	2466110	Ariatie	X.PSP	Done	25%

Padang Panjang, 09-10-2025
Headmaster

Nasrial, S.Pd
NIP: 196707261992031005

Figure 9. Scholarship acceptance report

3.1.4. Test

The next stage is software testing using blackbox testing to ensure that the functions and output are as expected, practical, efficient, and minimize errors, testing as follows[29]:

Table 1. Black box testing

No	Design and Process	Which are expected	Information
1	Go to the home menu page	Display the home menu page	websites can be opened
2	Go to the school's About page	Show page about school	The button was successfully operated
3	Open scholarship information	Display the scholarship information page	The button was successfully operated
4	Open the Student File Input Page	he file input page appears	The button was successfully operated
5	Click the file filling menu	Charging options appear	The button was successfully operated
6	Click the upload file menu	Show file upload options	The button was successfully operated
7	Click save	Data is saved	The button was successfully operated
8	open the scholarship announcement page	Display the announcement page	The button was successfully operated
9	Click edit	The edit page appears	The button was successfully operated
10	Login process	The login page appears	The button was successfully operated
11	Click process	The process results appear	The button was successfully operated
12	cick delete data	Data will be deleted	The button was successfully operated
13	Download the announcement results	PDF file of scholarship announcement results	The button was successfully operated

3.1.5. Deploy

At this stage, the decision-making system that has been built is implemented and tested by users to ensure its functionality is as expected[30]. Testing is carried out through validity, practicality, and effectiveness tests with results of 0.86 (valid), 0.97 (practical), and 0.87 (effective) respectively, so that the system is declared suitable for use.

Table 2. Validity Test Results

No	Validator Name	Score
1	Dr.Supratman Zakir M.Pd.M.Kom	0,75
2	Irman Efendi,S.Pd,M.Kom	0,97
3	Ryan Amanda,M.Pd.T	0,86

Table 3. Practicality Test Results

No	Validator Name	question						amount	Score mx
		1	2	3	4	5	6		
1	Fitra Gusnita,SPd.I	5	5	5	5	5	5	30	30
2	Witria Hari Putri,S.E	5	5	5	5	5	5	30	30
3	Achmad Fharuqi, S.S.I	5	5	5	5	5	4	29	30
Total Value Amount								89	90

Tabel 4. Effectiveness Test Results

No	Validator Name	Before				After			
		1	2	3	4	1	2	3	4
1	Fauziyah Hayati	20	20	20	40	100	100	80	100
2	Rahmat Tirpan Nur	20	20	40	20	100	100	100	80
3	Andre Hadhiswara	20	20	40	40	100	100	100	80
4	Ahmad Hafizd	20	40	40	20	100	100	80	80
5	Ganisa Zatullini	40	20	40	20	100	80	100	80
6	Habib Bullah	20	20	20	40	100	100	80	100
7	Larisa Zuri De	20	40	20	20	100	100	100	80
8	Afif Luqman	40	40	20	40	80	80	100	100
9	Andrian Maulana	40	40	40	40	80	80	100	100
10	M.Fadli	40	20	40	20	100	80	100	80
11	Irfan Hidayat	40	40	40	40	80	80	100	100
12	Ramadhani	40	40	20	40	100	100	80	80
13	Melinda Putri	40	20	40	20	100	80	100	80
14	Hayatul Nurdina	20	40	20	20	100	80	100	80
15	Haniya Putri Kyana	20	40	20	40	80	100	80	100
16	Khairani Fadilla	40	20	40	20	100	80	100	80
17	Tiara Tri Rahayu	20	40	40	20	100	100	100	80
18	Hapis	40	20	40	40	100	100	100	80
19	Khirania Putri	40	40	40	40	100	100	80	80
20	Imalatunil Khaira	40	40	20	20	80	80	100	100
21	Gufran Saputra	40	40	20	20	80	100	80	100
22	Darul Wasigani	40	20	40	40	80	80	80	100
Amount		700	680	700	660	2060	2000	2040	1940
Total Amount		2740				8040			
Average		31,13				91,36			

After the research instrument is declared valid, practical and effective, the next stage is data management using the Analytical Hierarchy Process (AHP) method.

Table 5. Pairwise comparison assessment scale

Level of Importance	Definition	Information
1	Equally Important	Both elements have the same influence
3	Little Matters	Experience and judgment heavily favor one element over its counterpart.
5	More Important	One element is very favored and practically its dominance is very real, compared to its partner element.
7	Very important	One element is proven to be very favored and practically its dominance is very real, compared to its partner element.
9	Absolutely More Important	one element is absolutely preferred over its counterpart, at the highest level of confidence
2,4,6,8	Middle value in between two opinions side by side	These values require a compromise

***Measurement Consistency Index*(CI)**

$$CI = \frac{\lambda max - n}{n-1} \quad (1)$$

Criteria:
a. Parental status = S
b. Income = P
c. Number of dependents = T
d. Residence = M
e. Achievement = R

Table 6. Pairwise Comparison Matrix

	S	P	T	M	R
S	1	1/3	2	4	1/2
P	3	1	5	7	3
T	1/2	1/5	1	3	2
M	1/4	1/7	1/3	1	1/4
R	2	1/3	1/2	4	1

Criteria Weight
S =0,2
P=0,25
T=0,25
M=0,2
R=0,1

Criteria Weighting Scores
a. Parental Status: Complete = 1, tl = 9
b. Income: Uncertain = 9, Little = 7, Sufficient = 1
c. Number of Dependents: Many = 9, Little = 1
d. Living with: Boarding = 9, Contract = 5, Private = 1
e. Achievements: Yes = 9, No = 1

Example of Percentage Data for School Fee Deductions Using the Analytical Hierarchy Process (AHP) Method.

Student X with

parental status	**:Tl=9**
Income	**: Little=7**
Number of dependents	**: Many=9**
Living	**: Boarding=9**
Achievemen	**t: Yes=9**

The percentage results of school fee deductions using the Analytical Hierarchy Process (AHP) method =

$$(TlxS) + (LittlexP) + (ManyxT)(RidexM) + (YesxR)$$

$$(9x0{,}2) + (7x0{,}25) + (9x0{,}25) + (9x0{,}1) = 8{,}5$$

So student X gets a 100% reduction in school fees.

3.1.6. Review

In the review phase, the trial results are analyzed to evaluate the system's suitability to user needs. Feedback from the guidance counselor, principal (admin), and students (users) indicates that the system functions well in supporting scholarship selection, although there are several minor improvements suggested for further development[31].

3.1.7. Launch

After the evaluation process is complete, the final stage, namely the system launch, is carried out. At this stage, system users are given guidance and training regarding the use of the scholarship recipient decision-making system, so that the system can be operated effectively and in accordance with the initial development objectives[32].

3.2. Discussion

SThe scholarship acceptance decision-making system developed using the Analytical Hierarchy Process (AHP) method is able to objectively assess student eligibility based on criteria such as parental status, income, number of dependents, residence, and achievements. This system produces decisions in the form of a percentage of aid (25%, 50%, 75%, or 100%) according to the student's condition, thereby increasing efficiency, transparency, and fairness in selection. This is in line with the development of 21st-century Decision Support Systems (DSS) that support fast, accurate, and interactive data-based decision-making. The results of this study are in line with previous studies that also applied AHP, although they have differences in object and focus, such as the selection of olympiads, web-based scholarships, or a combination of AHP and SAW methods. Thus, the application of AHP in DSS has proven effective and is expected to be an applicable and sustainable solution to support more targeted educational assistance policies.

4. Conclusion

Based on a series of studies that have been carried out, the author has succeeded in designing and building a SPK application that functions to assist the selection process for scholarship recipients at SMKN 2 Padang Panjang. The school offers several types of scholarships, namely the Smart Indonesia Program (PIP) scholarship, Rajawali Grant, Baznas, and school fee relief. The focus of this research is on the school fee relief scholarship. This system is designed to simplify the scholarship acceptance selection process which was previously carried out manually without the assistance of a system, which caused administrative delays and potentially caused errors. With this system, the selection process can be carried out more validly, practically, and efficiently. The test results show that the system has a validity level of 0.86, a practicality level of 0.97, and an effectiveness level of 0.97.

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