Implementation of Black Box Testing with the Application of Equivalence Partitioning Techniques in the M-Magazine Android Application at Semen Gresik High School

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Article Info	Abstract
	This research aimed to improve the M-Magazine application at Semen Gresik High School to enhance its usability for students and teachers. The study focused on developing a digital platform called "mading" to improve the dissemination of information within educational institutions. The research addressed security issues and limitations associated with physical media by transitioning from traditional wall-mounted magazines to a digital format. The research followed a three-phase approach consisting of preparation, analysis, and implementation, which involved a literature review, data collection, system design, and testing. The resulting digital Magazine system offers a centralized platform for schools to manage and share information. Students can actively contribute by submitting content through the website. The system provides features to sort, filter, and publish information, ensuring timely and relevant updates. The findings demonstrated that the Digital Magazine effectively improves information dissemination in schools by providing better security, accessibility, and efficiency than traditional methods. This technology-powered platform empowers schools and students to share knowledge and stay informed.

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INTRODUCTION

Currently, advances in information and computer technology, both in terms of hardware and software, are experiencing rapid development. The growth of information technology has a major impact on various sectors of society, such as business, social, and education [1]. In this context, software testing is a process that has been defined by a group of testers or software developers, involving an assessment of a software item, several connected software items, or even an entire thoroughly inspected software package [2]. Information is data that has been processed and organized so that it has meaning or value for the recipient or user. It involves setting, interpretation, and context that provide a deeper understanding of a subject. Information provides new knowledge, insights, or views that can be used to make decisions or understand a situation [3]. Information is the result of data processing with a specific purpose, in accordance with information, notifications, news, information, or other concrete materials that can be used as material for analysis, research, and making conclusions or decisions [4] .

Wall magazine, also known as Mading, is one of the tools to disseminate information in an educational environment. Mading is a temporary information medium and contains various information or topics related to the general public [5] [6]. M-Magazine is an Android application designed using Eclipse and PHP-MySql as its programming language. This application consists of two panels, namely the Website-based administration panel managed by the admin and the Android-based application panel

that can be accessed through an Android device [7] . A magazine is a periodical publication that usually contains articles, images, illustrations, and advertisements. Magazines are generally published periodically, such as monthly or weekly, and have a varied coverage of topics, including news, entertainment, fashion, lifestyle, science, technology, and more. Magazines can be printed in paper format or published digitally [8]**.**

With mobile applications, users can carry out various activities with ease and connect effectively in various places [9]. Websites usually contain certain information or functions that are arranged in an orderly manner and can be accessed by users through their browsers [10]. In addition, Android can also be used with an Apache Software license (ASL/Apache2), allowing redistribution of this operating system as well as permitted modifications [11]. MySQL is responsible for managing structured data collections with more than 6 million installs in various parts of the world. Through MySQL databases, you can add, access, and process data stored in databases more efficiently and effectively [12].

Software testing is the process of running programs to identify and correct errors, ensuring that the software behaves as expected. It involves inspecting software components and comparing actual performance with expected outcomes to produce a quality product. The primary goal is to detect and prevent errors that could cause losses, making thorough testing essential for delivering reliable software [13][14].

Black Box testing is a software testing method that focuses on the external functions of the software without requiring knowledge of the internal code or logic. It detects functional errors, database issues, data structure problems, interface errors, user mistakes, performance flaws, and errors in initialization and termination [15]. The amount of test data is determined by the number of input fields, input rules, and the upper and lower input limits that meet the specifications [16]

The use of information systems in education, especially in schools, is crucial for supporting the effectiveness and efficiency of the learning process. SMA Semen Gresik, as a progressive educational institution, has implemented the M-Magazine Android application as a supporting tool. However, due to the application's complexity, systematic and thorough testing is necessary to ensure its reliability and safety. Each method has a different level of prediction accuracy. Several researchers proposed improved methods of several methods. The improved method shows a better level of prediction accuracy, one of which uses an integrated system [17].

This research is supported by several studies, including those showing that schools often use a source of information called Mading. During online learning, however, the process of disseminating information has not been optimally received by all students. It is necessary to be attentive and thorough to ensure that information reaches everyone effectively [18]has recorded 9 million page viewers and 1.8 million sessions in Indonesia until 2020. This is inseparable from their digital marketing communication efforts. Therefore, this study aims to describe the implementation of digital marketing communication in Gettinlow's online magazine. Another research is [19] e-magazine are filled in by students and teachers at MTs Ar-Roihan Lawang Malang in turn. There is no urgency to include other research results in this context. The media expert validator gave a score of 3.78, and the content validator provided a score of 4.17, both in the "good" category. Additionally, interviews revealed that 85% of students opened the madrasah e-magazine to read it, highlighting the platform's effectiveness without needing further external validation.

In this study, the focus is on the implementation of information systems using the Black Box Testing approach, specifically the Equivalence Partitions technique. This method is widely supported by existing research, as it helps reduce the number of test cases by grouping inputs with similar behavior into partitions. Studies have shown that the Equivalence Partitions technique simplifies testing while ensuring comprehensive coverage, enabling the system to perform optimally across various scenarios. Researchers often choose this approach because it efficiently identifies defects and reduces redundant testing efforts. In the digital era, the shift from conventional wall magazines (Mading) to digital platforms, such as the M-Magazine Android application, introduces new challenges related to security,

accessibility, and efficiency. These three aspects of quality are emphasized because conventional wall magazines often suffer from limited access, manual content management, and vulnerability to physical damage, making them inefficient in disseminating information widely and securely. Security is crucial to protect sensitive data and prevent unauthorized access, which is a common risk in digital environments but not addressed by traditional Mading. Accessibility ensures that all users, including those with disabilities or limited resources, can access the content, which is a limitation of conventional wall magazines, where physical access is restricted to specific locations. Lastly, efficiency is key in delivering information quickly and updating content without the delays inherent in physical media.

The contribution of this study is to provide a practical guide for developers and stakeholders on how to implement testing techniques, particularly Black Box Testing and the Equivalence Partitions technique, to improve the security, accessibility, and efficiency of digital applications like M-Magazine, thereby enhancing the overall quality and reliability of such systems.

METHODS

This study carried out the process through several steps, including designing test scenarios, software testing, Black Box testing [20], and applying Equivalence Partitioning techniques, as seen in Figure 1.
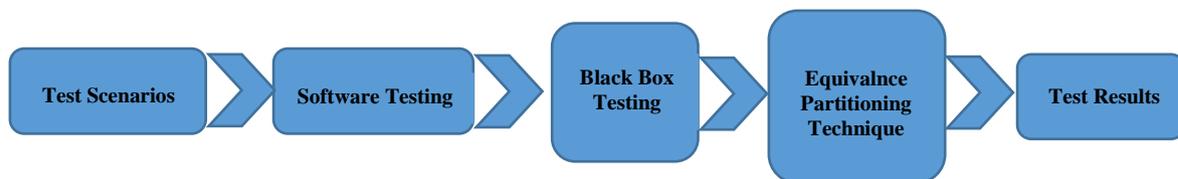
Figure 1. Black Box Research Method Scheme [20]

Test Scenarios

In the initial stage, planning begins with preparing the software to be tested and determining the type of testing, namely Black Box Testing [21]. Then, the next step is to set a test case using the Equivalence Partitions method for a specific form or page in the software. The goal is to obtain a dataset in the form of test documents using the Equivalence Partitions method and evaluate the level of effectiveness.

Software Testing

This stage involves determining the software to be tested [22], namely the M-Magazine application. Testing will be carried out in the website-based admin section, and in the Android-based user section. Some forms that will be tested involve tasks on the admin part, such as adding users and announcements, while on the application section, testing includes the process of registration, login, adding information by users, and user responses to the information contained in the application.

Blackbox Testing

The type of testing applied is Black Box Testing[20], which focuses on testing detailed aspects of the M-Magazine application, including the interface and functions on each page. Black Box Testing does not involve testing on the source code of the program but rather is oriented to evaluating the appearance of a functioning program based on its functionality. Thus, the main focus of this test lies in examining the information and functions contained in each program form.

Equivalence Partions Technique

The equivalence partitions technique [23] is used by dividing inputs into valid and invalid equivalence classes. This division is so that if an error occurs in one test case, a similar error will appear in another class. This assumption is designed so that one class can represent an input value.

Test Results

This stage is testing to evaluate the results of the application using a table of compiled test cases. Test results [24] identify test cases that have worked as expected and those that have not achieved the goal.

RESULT AND DISCUSSION

Several important differences arise in the analysis of conventional wall magazines and M-magazines. Notably, security, accessibility, and efficiency are three key aspects. Table 1 provides a comparison of the two formats. The supporting discussion from the comparison in each aspect includes:

Aspect Security

Conventional Wall Magazines: Physical vulnerability is a major concern. Notices can be easily vandalized, torn down, or stolen. Limited control over access exists since anyone physically present at the school can view the content. Sensitive information could be exposed if not carefully considered. M-Magazines: Offer a more secure platform. User access can be controlled with passwords or login credentials. Digital content is less prone to physical damage compared to paper. However, digital security measures are crucial to prevent hacking or unauthorized access.

Aspect Accessibility

Conventional Wall Magazines: Accessibility is limited to the physical location of the bulletin board. Students and teachers can only access information when they are physically present at school and during school hours. This can be inconvenient for those who need information outside of school hours. M-Magazines: Provide greater accessibility. Users can access the M-Magazine app anytime and anywhere with an internet connection. This allows for greater flexibility and ensures that everyone has equal access to information, regardless of their location or schedule.

Aspect Efficiency

Conventional Wall Magazines: Updating content on a physical bulletin board can be time-consuming. New information needs to be printed and physically placed on the board, and old content needs to be removed. Additionally, the amount of information that can be displayed is limited by the physical size of the board. M-Magazines: Offer significant improvements in efficiency. Updates can be made quickly and easily through the app's interface. New content can be uploaded instantly, and there's no limit to the amount of information that can be stored. This saves time and allows for a more dynamic and up-to-date flow of information.

Table 1. Comparing Conventional Wall Magazines and M-Magazines

Aspect	Conventional Wall Magazines	M-Magazines
Security	Vulnerable to vandalism, damage, and theft. Limited control over access.	Secure digital platform with controlled access. Lower risk of physical damage.
Accessibility	Limited to the physical location of bulletin boards. Restricted to school hours.	Accessible anytime and anywhere with an internet connection.
Efficiency	Time-consuming to update and maintain. Limited space for content.	Easy and quick updates. Unlimited space for content.

Result from Application

The development team performs product coding in the implementation phase by analyzing requirements and identifying more detailed coding tasks. These tasks are broken down into smaller parts, which can be worked on on a daily basis to achieve the final result.

Stages of Research

Testing begins with drawing up a test case scenario based on the desired results of the program. Several application forms are tested, and the results are evaluated whether or not they are appropriate according to the program's response. If the results do not match, improvements are made. Test case scenarios: The research began by creating a test case to test the M-Magazine application using the Equivalence Partitions method. Table 1 shows the test cases and expected results for the application. The test case includes input commands tested in M-Magazine. Overall, Table 2 examines whether the *M-Magazine* application is in accordance with the desired needs or still requires revision.

Table 2. Test scenarios

Code	Test Case	Expected results
P01	Clicking on the Home menu	The system displays the page from the Home application.
P02	Register by leaving the name and password fields blank	The system receives a registration request and displays a "Registration Success" alert.
P03	Register by filling in all data correctly.	The system receives a registration request and displays a "Registration Success" alert.
P04	Login by clearing all fields.	Login by clearing all fields. The system rejects the login request and
P05	Login by filling in the fields in accordance with the provisions	The system displays the main page of the M-Magazine user login application
P06	Login by filling in the fields in accordance with the provisions	The system receives a request by displaying a "Login Successful" alert
P05	Login by filling in the fields in accordance with the provisions	The system displays the main page of the M-Magazine user login application
P06	Login by filling in the fields in accordance with the provisions	The system receives a request by displaying a "Login Successful" alert
P07	Modify or update user data	The system displays the updated user data page
P08	Modify or update user data	The system receives a request by displaying the alert "Data successfully updated"
P09	Click the article menu by the user	The system receives requirements by displaying the article menu page
P010	Click the message menu	The system receives a request by displaying the message menu page
P011	Click the message menu	The system receives a request by displaying a pop-up menu "Read, not read, All"
P012	Click the article category menu	The system receives a request by displaying the article page
P013	Fill in comments on existing articles	The system receives the request and displays a comment on the comment
P014	Click the message list category menu	The system receives the request and displays the entire message list

Equivalence Partitions Test Case

M-Magazine *testing* involves several forms with *test cases* that have been prepared. A total of 14 test data were tested with Code P01-P014, and the results were coded T01-n. Evaluation of results aims to determine whether the system is operating as expected.

Table 3. Equivalence Partitions Test Case

Code	Test Case	Expected Results	Test Results
T01	Open M-Magazine Apps; See Menu View; Select Home Menu; Click	The system displays the page from the Home application.	The system displays the page from the Home application.
T02	Display Register; Enter Name; Enter Password; Create	The system rejects the registration request, and the password must be filled in".displays alert "failed register, data field name	The system rejects the registration request but does not display an alert
T03	Display Register; Enter Name; -Enter Password; -Create	The system rejects the registration request and displays an alert: "Failed register, data field name"	The system receives a registration request and displays a "Registration Success" alert.
T04	Page Login; Enter username; -Enter password; -Create	The system rejects the login request and displays an alert of "failed login,	The system rejects the login request and displays a "failed login" alert.
T05	Page Login; Enter username; elfina Enter password; el123 Create	The system displays the main page of the M-Magazine user login application	The system displays the main page of the M-Magazine user login application
T06	Login Page; Enter username; elfina Enter password; el123 Create	The system receives a request by displaying a "Login Successful" alert	The system receives a request by displaying a "Login Successful" alert
T07	Login Page; OK Enter user menu; OK Update user data; OK Create	The system displays the updated user data page	The system displays the updated user data page
T08	Login Page; OK Enter user menu; OK Updatae user; OK	The system receives a request by displaying an alert	The system receives the request but does not display an alert.
T09	Click the article menu by user Login Page; OK Enter Article Menu; OK request	"Data updated successfully" The system received a request by displaying the article menu page	The system receives request by displaying the article menu page
T010	Login Page; OK Enter Menu Message; OK request	The system receives a request by displaying the message menu page	The system receives a request by displaying the message menu page
T011	Login Page; OK Enter Menu Message; OK request	The system receives a request by displaying a pop-up menu "Already	The system receives a request by displaying a pop-up menu "Read, not read, All"
T012	Login Page; OK Enter Article; OK request	The system receives a request by displaying the article page	The system receives a request by displaying the article page
T013	Login Page; OK Enter Comment; OK Create	The system receives the request and displays a comment on the comment	The system receives the request and displays a comment on the comment
T014	Login Page; OK Enter Message; OK Request	The system receives the request and displays the entire message list	The system receives the request and displays the entire message list
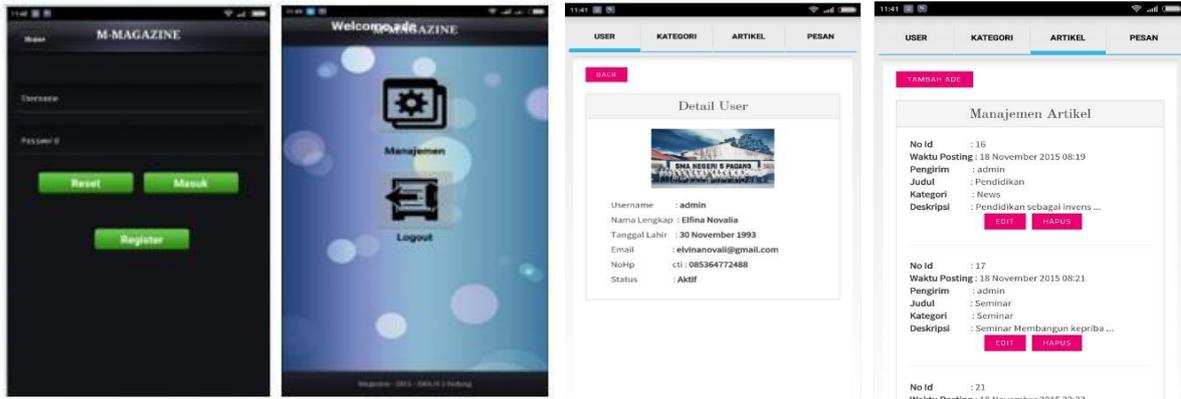
Figure 2. Login Form, User Data Form, Article Menu Form

Test Results

Based on test case testing using the Equivalence Partitions method in the *M-Magazine* application, documented test results were found in Table 4. Thus, the test results can be summed up as follows.

Table 4. Test results

No	Test Case	Test Results	Conclusion
1	P01	T01	Appropriate
2	P02	T02	Not Compliant
3	P03	T03	Appropriate
4	P04	T04	Not Compliant
5	P05	T05	Appropriate
6	P06	T06	Appropriate
7	P07	T07	Appropriate
8	P08	T08	Not Compliant
9	P09	T09	Appropriate
10	P010	T010	Appropriate
11	P011	T011	Appropriate
12	P012	T012	Appropriate
13	P013	T013	Appropriate
14	P014	T014	Appropriate

The tests in Table 3 show the results of 14 M-Magazine application tests using the Equivalence Partitions method with test case instruments. From these results, it was noted that 13 tests were successfully appropriate, while 3 tests were not suitable, as shown in Figure 3.

After the mobile-based online magazine application at Semen Gresik High School, access to school information has become much easier and more efficient. With the M-Magazine application, which can be downloaded and accessed through Android devices, students and teachers can now get the latest information, news, articles, and school announcements right in their hands. This app allows them to stay connected with school activities, even when not on the premises. In addition, the app offers interactive features such as commenting and content sharing, which increases the engagement of the entire school community in discussions and active participation. As a result, communication at SMA Semen Gresik has become more effective, and the culture of information sharing in the school has flourished, creating a more dynamic and inclusive learning environment.

After implementing the M-Magazine online magazine at Semen Gresik High School, testing was carried out using Black Box Testing with the application of the Partition Equivalence Technique to ensure that the application functions properly according to user needs. This technique divides the application input into several partitions or groups that are considered equivalent to identify various operational conditions. This test aims to test each of the application's main features, such as navigation between articles, multimedia content loading, article search, and user interaction, using various types of data and usage scenarios. The results of these tests show that the M-Magazine application is capable of handling a wide range of inputs and situations without experiencing significant system interruptions or errors. Thus, the use of the Partition Equivalence Technique in Black Box Testing has proven to be effective in ensuring that the M-Magazine application runs smoothly and meets the needs of students and teachers at SMA Semen Gresik, thereby improving efficiency in information dissemination and school community engagement.
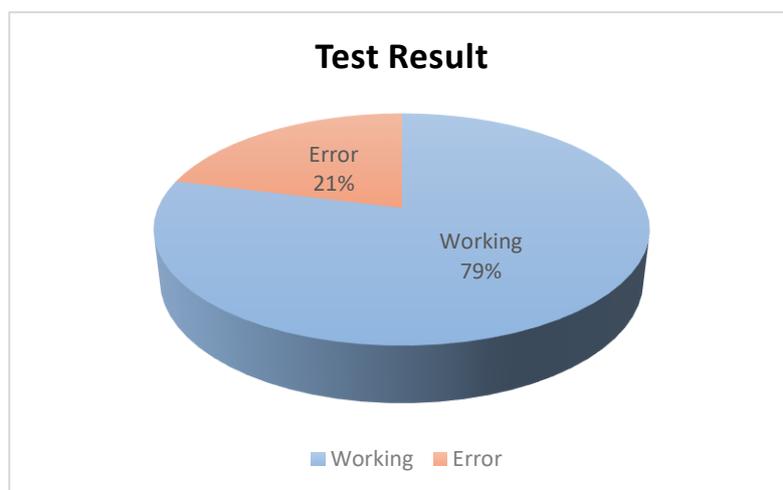
Figure 3. Test Results

Research on implementing the online magazine M-Magazine at Semen Gresik High School using Black Box Testing with the application of the Partition Equivalence Technique was strengthened through a comparative study comparing the effectiveness of Black Box Testing and White Box Testing. Based on "A Comparative Study of Black Box Testing and White Box Testing" [26], Black Box Testing is more effective in identifying errors related to functionality and user interface because this approach does not require a deep understanding of the application source code. In the context of testing M-Magazine, Black Box Testing with the Partition Equivalence Technique allows the development team to test how the application responds to various user inputs and ensure that each feature runs smoothly without the need to know the internal structure of the program code. Thus, this test focuses more on the actual user experience and is more relevant to ensure that the application can be accessed and used easily by students and teachers at Semen Gresik High School. In contrast, White Box Testing, which focuses more on testing the internal structure and logic of the program, although useful for detecting logical and security errors, is less relevant in the context of applications whose use is more oriented towards user interaction and accessibility. The results of this study confirm that the use of Black Box Testing with the Partition Equivalence Technique is an appropriate and effective approach to testing the M-Magazine application in the context of its use in a school environment.

Other research supporting the implementation of the online magazine M-Magazine at Semen Gresik High School using Black Box Testing with the application of the Equivalence Partitioning Technique [27] is further strengthened by the results of similar research on the E-Buk Kades application using the Boundary Value Analysis and Equivalence Partitioning techniques. The research shows that the Equivalence Partitioning Technique, which divides inputs into equivalence groups, is very effective in identifying various scenarios that users or developers may not think of. The results of the E-Buk

Kades study revealed that the use of the Partition Equivalence Technique successfully detected various functional errors and improved the stability of the application by testing different input conditions. Similarly, the application of the Partition Equivalence Technique to the testing of the M-Magazine application ensured that it was able to handle a variety of user inputs and function optimally under different conditions. This research underscores the importance of this testing technique in ensuring the reliability and functionality of applications, especially in educational environments such as Semen Gresik High School, where accessibility and ease of use are crucial for students and teachers.

CONCLUSION

Testing the created application using white box and black box approaches is important. In testing the M-Magazine application, the black box method was used to apply the Equivalence Partitions technique. The testing process begins with the definition of the test instrument, also known as the test case. 14 test cases were created to test parts of the application form, with 11 tests being successful and as expected and 3 tests not meeting expectations. Identifying inappropriate functionality during testing allows early fixes to improve the quality of the software/application. Based on the research results in M-Magazine above, we can conclude that The magazine has changed from a print format to an Android-based version. In the digital age, schools can easily share information without space and time constraints. Therefore, the distribution of media information becomes faster and more effective. The M-Magazine application increases the effectiveness and efficiency of school activity information and facilitates access to everything related to school magazines. M-Magazine, which uses Java Mobile, PHP and MySQL databases, increases its attractiveness in the process of data sharing.

Sandvig et al. identified five general concepts for algorithm audits, four of which are applicable to black-box systems [25]. This section discusses these four audit forms and how the presented test methods can be used to analyze the resulting data. Our research revealed a lack of consistent terminology regarding black-box testing, making it challenging to find relevant information and compare similar concepts. This is partly due to the absence of established textbooks and dedicated conferences or journals focused on black-box testing and auditing for ADM systems [26]. Overall, the M-Magazine application demonstrates a successful use of technology to enhance educational communication.

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