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## Prototyping a Web-Based Application for Remedial Education Data Management

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**ABSTRACT:** The Sistem Pengurusan Data Program Pemulihan Khas (SPD) is a web-based application that focuses on managing data for a remedial education program in 28 primary schools across Cameron Highlands, Pahang. It is a computerized system designed to replace the manual system that currently uses Microsoft Excel forms to manage pupils' information. The system's features enable tracking of the pupils' academic progress and providing data for upper management decision-making. This system is intended for use by remedial teachers to manage pupils' information, school authorities to monitor the program, and education officers at the district level. In developing the system, a system prototyping development methodology was adopted. Functional requirements were gathered through meetings with clients and a prototype called "SPD" was created based on these requirements. A field study was conducted to assess the prototype's usability, and the results indicated that SPD is straightforward and easy to use. The study contributes to understanding the system requirements and user interface of the web-based application for managing information and data related to remedial education.

**Keywords:** Remedial Education, Student Management System, Data Management, ICT In Education, Educational Technology



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## INTRODUCTION

Computer applications have started to be used for school management since the 1970s (Harland et al., 2014). During this time, information and communication technology (ICT) in educational institutions was used mainly to enhance the efficiency of school offices, such as to store data of pupils and staff (Abuka Victor Deju, 2019). The developments of various ICT innovations have made a significant impact, especially to systematically record all types of information in educational institutions (Samah et al., 2016). Nowadays, the nature of educational management has already shifted due to the rapid technology changes. This phenomenon is not only happening in universities, higher education institutions, or secondary schools, but also at the primary school

level. Considering the vital role of early childhood education, primary schools must also have their own management system. Similarly, obtaining and evaluating data from various sources with multiple users provide an important benefit for educators and administrators for understanding pupils' needs, improving teaching methodology and academic performances (Forrester V. V., 2019).

However, the current data management system in the remedial program is considered outdated, stressful, and cannot satisfy the current education needs (Cantabella et al., 2019; Lerche & Kiel, 2018; Stantchev et al., 2014). As a result, complaints regarding data loss, errors, and data complexity is common among remedial educators and education officers (Awang et al., 2018a). Therefore, there is an urgent need for educational institutions to have a systematic data management system to manage remedial data easily and without stress. This includes the data of teachers, schools and pupils, which are useful for various purposes, especially at the decision-making level like Pejabat Pendidikan Daerah Cameron Highlands (PPDCH). As a result, a system called Sistem Pengurusan Data Program Pemulihan Khas (SPD) is developed to improve the current manual data management practice. The current manual system only lets remedial teachers to keep data and records of their pupils manually by filling in existing Microsoft Excel templates or forms. The remedial education program needs a proper system to assist teachers in recording their pupils' academic performance. This data is important for teachers, the school authorities, and PPDCH to come up with proper decision-making (Juhaňák et al., 2019; Rajagukguk et al., 2023; Yun & Park, 2023).

By all means, data management is crucial in education (Attaran, Stark, & Stotler, 2018) & (Bamiah, Brohi, & Rad, 2018). Due to current ramifications in remedial data management, there is an urgent need for a mechanism that could record data efficiently. The use of a web-based application is a good solution to fill the gap, due to its ability to automatically generate data, thus, the procedure becomes more efficient and time-saving (Jeerapornchai, Chonchirdsin, & Pornsakulsakdi, 2019); (Diyana, Nathali Silva, Han, Cao, & Han, 2022). As such, the use of SPD is hoped to facilitate the users, which are education officers, school authorities and teachers in remedial data management as well as decision making. As compared to the manual system, the computerized system would totally upgrade and improve the current data management practice (Romero & Ventura, 2020). Therefore, this study aims to investigate the significance of a web-based application as a tool for remedial education data management. Furthermore, this study aims to design, develop and evaluate the SPD, which is a web-based application for systematic remedial data management. Consequently, it is hoped that this study will provide a better understanding of the system requirements as well as be a reference model for developers and researchers to improve the educational data management system. The next section discusses the background and related prior studies. Then, the latter section describes the design and development, followed by the usability evaluation of SPD. Finally, the last section concludes the study and suggests future works.

Computer applications have started to be used for school management since the 1970s. During this time, information and communication technology (ICT) in educational institutions was used mainly to enhance the efficiency of school offices, such as to store data of pupils and staff (Abuka Victor Deju, 2019). The developments of various ICT innovations have made a significant impact (Omar et al., 2018), especially to systematically record all types of information in educational institutions. Nowadays, the nature of educational management has already shifted due to the rapid

technology changes. This phenomenon is not only happening in universities, higher education institutions, or secondary schools, but also at the primary school level. Considering the vital role of early childhood education, primary schools must also have their own management system. Similarly, obtaining and evaluating data from various sources with multiple users provide an important benefit for educators and administrators for understanding pupils' needs, improving teaching methodology and academic performances (Forrester V. V., 2019).

This section describes the background of remedial education and its related studies in the context of Malaysian education. Then, this is pursued by the discussion on the role of ICT in facilitating the creation and management of educational data. Remedial Education Program in Malaysia is provided for pupils who have difficulties in mastering the 3R's (reading, write, arithmetic) skills due to environmental factors (Kasran S. B, H. Toran, and A. M. Amin, 2012). This program is conducted by well-trained teachers. Besides the isolation class in primary schools, the remedial program involves the continuous process that is made available starting from pre-school, primary school, up to the secondary education level in normal academic and vocational streams (Taib M. N. B. M, n.d.). Implementing this program requires inter-related processes. Some of the processes are the determination of pupils' eligibility, screening, diagnosing, intervention, implementation and follow-up. The Remedial Education Program is one of the efforts in education to overcome the learning problems among pupils in primary schools which particularly focused on basic skills of reading, writing and arithmetic. This is done under the supervision of remedial teachers who have undergone special training in this field. This program is essential in Malaysian education as if these pupils are not given the remedial lessons, they might fail to acquire the necessary education and their potential would be wasted.

Meanwhile, some past studies reported that although the Remedial Education Program was initiated in Malaysia since long ago, it is still not effective enough to empower the 3R among primary school pupils, especially the basic reading skills. Based on the result of a survey to the remedial teachers, it was discovered that three major problems triggered this issue: (i) the difficulty in obtaining a suitable room for remedial classes, (ii) difficulty in obtaining financial assistance for purchase learning materials, and (iii) poor support from headmasters and colleagues. In addition, the excessive teachers' workload also contributes to this undesired phenomenon, as they are not only teaching remedial classes but also burdened by other duties such as extracurricular activities and administration tasks. Difficulty in obtaining a suitable room for remedial classes happens when some of the schools do not have a special room for remedial classes while difficulty in obtaining financial assistance leads to insufficient teaching aids. On the other hand, poor support from colleagues explains that school administrators gave more priority to the mainstream classes compared to special remedial classes.

Furthermore, the analysis of existing systems that have similar features is also conducted. The analysis of other existing systems helps to understand how the system works. From there, we will get knowledge of the design that was made by others before adopting our own project. This analysis is important to have a new and high-quality website. The outcome from this analysis, in terms of the strength and weaknesses of existing systems, should be useful as guidance for SPD development. Table 1. Constructs and measures. Table 1 summarizes some of the existing computerized applications under the Ministry of Education Malaysia (Moe)

**Table 1. List of Application for Managing Education Operation**

<b>Educational Applications</b>	<b>Description</b>
<b>Sistem Rancangan Pendidikan Individu Secara dalam Talian (e-RPI)</b>	A system for the planning and implementation of 'Rancangan Pendidikan Individu' for pupils with special needs. The implementation of e-RPI requires the cooperation of educators, schools and parents. This system is produced to assist educators to design pedagogy for pupils with special needs.
<b>Modul Pengurusan Murid ePKHAS</b>	This system is developed to store, process and access information on the selection and placement of pupils to Form 1 and Form 4 to special needs education schools.
<b>Aplikasi Pangkalan Data Murid (APDM)</b>	This system is the main application in the Ministry of Education and some agencies. This system can be accessed by teachers or officers assigned by the principal or headmaster to enter all data related to pupils.

The Sistem Rancangan Pendidikan Individu Secara Dalam Talian (e-RPI) (Fig. 1) users are Ministry of Education Malaysia, State Education Department, District Education Office, School Principal, Senior Administrative Assistant Teacher (Remedial Education School), Class Teacher and Subject Teacher. Each user has a specific role. For example, the Ministry of Education Malaysia is responsible to monitor the implementation of e-RPI at the MOE level and act as the e-RPI help desk. Next, the State Education Department is responsible to monitor the implementation of e-RPI at the state level and also acts as the e-RPI help desk. Meanwhile, the District Education Office is responsible to assist in monitoring the implementation of the system at the district level. In addition, the school principal has to monitor the implementation of the system at the school level and the senior administrative assistant acts as the school's e-RPI coordinator who completes the information on students, staff and class teachers in the e-RPI system every year. The class teacher is responsible to send a draft of Pelan Infrastruksional Individu (PPI) to parents before the conference while the subject teacher has to plan and implement PPI according to the subjects taught ("Sistem Rancangan Pendidikan Individu (e-RPI)", Accessed: Jun. 26, 2021. [Online]. Available: <https://ppirpi.moe.gov.my/>," n.d.).



Figure 1. Front Page of e-RPI

The users of Modul Pengurusan Murid ePKHAS (Fig. 2) consists of teachers, related units in JPN, schools and lastly parents (“Manual Pengguna (Sekolah/Guru Penyelaras) Sistem Permohonan Penempatan Murid Berkeperluan Khas (Epkhas) Ke Tingkatan 1 Dan Tingkatan 4 Di Smpk/Smpkv/Kv Keningau.” Accessed: Jun. 26, 2021. [Online]. Available: <https://epkhas.moe.gov.my/Permohonan/Dokumen/M>,” n.d.). This system focuses on the admission of pupils from form 1 and form 4 to SMPK and SMPKV (e-PKHAS). Teachers are responsible to fill in the details of the pupils, their parents or guardians. They also need to fill in the Co-Curriculum information as well as the student’s position (Sosanto Azhar And Meiryani, 2019).



Figure 2. Front Page of ePKHAS

Aplikasi Pangkalan Data Murid (APDM) (Fig. 3) is a student management module that can be accessed by teachers or officers that are assigned by the school principal to enter e-attendance and all data related to students. The student management application is very important in handling student data at the school level, Pejabat Pendidikan Daerah (PPD) and Jabatan Pendidikan Negeri (JPN). The admin of Aplikasi Pangkalan Data Murid (APDM) responsible to register a new class, make changes to the existing class teacher and class name, delete the existing class, and verify all student’s data. This system also allows teachers to sign in to the system. Teachers can register a new class, change an existing class teacher, update an existing class name, delete an existing class, updating student information and delete student records due to moving schools or overlapping records ((Awang et al., 2018); (Cheok, M. L., Wong, S. L., 2017)).



**Figure 3. Front Page of APDM**

Table 2 shows the comparison of strength and weakness between the existing systems; Sistem Rancangan Pendidikan Individu Secara dalam Talian (e-RPI), Modul Pengurusan Murid ePKHAS and Aplikasi Pangkalan Data Murid (APDM).

Table 2. Pilot Study Reliability Analysis

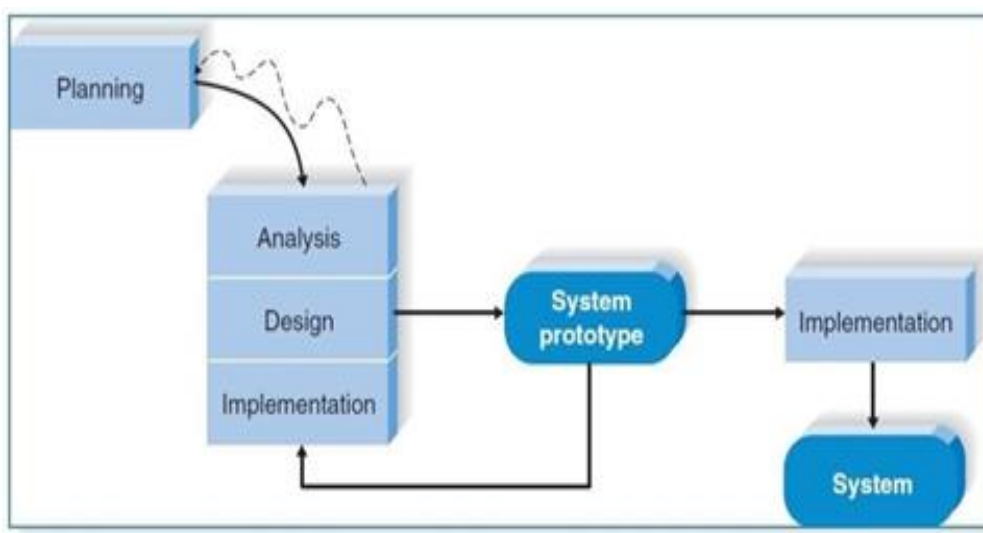
System	Strength	Weakness
<b>e-RPI</b>	<ul style="list-style-type: none"> <li>- Allows multiple users to log in to the system.</li> <li>- Have many features.</li> </ul>	<p>The online application keeps on under maintenance, users have to download multiple documents to ensure that the RPI remains implemented.</p>

		- Complex user interface
<b>ePKHAS</b>	- Easy to use. -Simple and consistent user interface.	- Users are advised to use only the Google Chrome web browser to launch the system smoothly.
<b>APDM</b>	- Secure system as it has “I’m not a Robot” authentication..	- Dull user interface - Complex user interface

Although many educational web-based applications are available, but none of them are related to remedial education data management. Thus, there is still a need for the research and development of a new web-based application so that it can reduce the effort and time spent in the manual remedial data management system.

## METHOD

One of the aspects of development that needs to be considered in the system development process is methodology. There are many types of software development methodologies such as waterfall, scrum, prototyping, extreme programming and Rational Unified Process (RUP) [10]. The development method that is used for building this web-based system is prototyping. Prototyping allows users to evaluate the prototype and try it out before the real implementation. It also helps to understand the user-specific requirements which might not be considered by the developer during product design. The steps involve four main phases namely planning, analysis, design and implementation, as depicted by Fig 4.



**Figure 4. System prototyping (Dennis et. al, 2018)**

The planning phase involves the requirements acquisition of the web-based application for managing remedial information and data. The requirements are documented and visualized using Unified Modelling Language (UML) diagrams including the use case, activity and class diagrams. UML diagrams provide a standardized way of modeling workflows as well as a wider range of



features to improve readability and efficacy. The literature review on the previous studies related to web-based systems is also done at this phase. Next, the analysis phase allows this study to identify the list of requirements and functions needed in the system after having discussions with clients. Additionally, the design phase is performed concurrently, where the user interface of the web-based application is designed. Users are involved during the design and construction process where they provide feedback for improving the user interface and information flow of the system based on the client requirements. During the implementation phase, the low-fidelity prototype is constructed. Report and presentation are also done in this phase to get feedback from the client. During the system prototype phase, this study analyzed and make improvements based on the client's feedback on the prototype. Finally, the prototype will be implemented on the client platform. The system will be tested before the final release. A detailed explanation of each phase is presented in the following sections.

## RESULT AND DISCUSSION

### Design And Development of the SPD

This section describes the design and development of the SPD, following the first three phases of system prototyping. It is divided into two sub-sections: (i) the requirements of SPD, and (ii) the prototype development of SPD. Through this phase, the functional and non-functional requirements are refined to discover the real needs of the system. UML diagrams are used to represent the components or elements of the proposed system in graphical forms. As a result, the phase of requirement analysis and design gives a holistic understanding of system development.

A requirement gathering process was carried out by discussions and meetings with the users of the system who will manage information and data related to the remedial program. In addition, the previous studies related to pupil's data management in primary school, secondary school and higher learning institutions were reviewed. The discussions and meetings were conducted informally through the Zoom application from time to time. They were asked a few open-ended questions primarily on the features of the system. Some of the questions that have been asked are such as, (i) "what are the functions that you would like to have in the system?", (ii) "how would you like to log in to the account?", (iii) "how would you like to add information about the pupil?", and (iv) "how would you like to update the pupil's information?" Their opinions were recorded and the requirements were applied to the system design. Later, the respondents were actively involved during the implementation phase where the interface of the prototype was shown to them to get their feedback and comments. The gathered requirements are listed in Table 3, Table 4, and Table 5.



Table 3. The List of Requirements for Ppdch Officers

<b>ID</b>	<b>Requirement</b>	<b>Priority</b>
<b>1.</b>	<b>NEW USER REGISTRATION</b>	
<b>1.1</b>	The system should allow PPDCH officers to register users.	Mandatory
<b>1.2</b>	The system should allow PPDCH officers to set usernames and passwords for new users.	Mandatory
<b>2.</b>	<b>VIEW DATA</b>	
<b>2.1</b>	SPD should allow PPDCH officers to view pupil's data	Mandatory
<b>3.</b>	<b>LOCK FORM</b>	
<b>3.1</b>	SPD should allow PPDCH officers to lock pupils' achievement data form.	Mandatory
<b>3.2</b>	PPDCH Officers may open the form during the data collection period.	Mandatory
<b>4.</b>	<b>GENERATE REPORT</b>	
<b>4.1</b>	SPD should allow PPDCH officers to generate pupils' reports.	Mandatory
<b>4.2</b>	SPD should allow PPDCH officers to generate pupils' reports based on the school level and district level.	Mandatory
<b>5</b>	<b>ENDORSE DATA</b>	
<b>5.1</b>	SPD should allow PPDCH officers to endorse the submitted pupils' data.	Mandatory
<b>5.2</b>	SPD may display the status whether it is verified or not.	Desirable
<b>6.</b>	<b>REMOVE USER</b>	
<b>6.1</b>	SPD should allow PPDCH officers to remove the remedial teacher's account.	Mandatory
<b>7.</b>	<b>COMMUNICATION SECTION</b>	
<b>7.1</b>	SPD should allow PPDCH officers to communicate with teachers and school authorities.	Optional
<b>7.2</b>	Asking and answering questions can be performed in a discussion forum.	Optional

Table 4. The List of Requirements for School Authorities

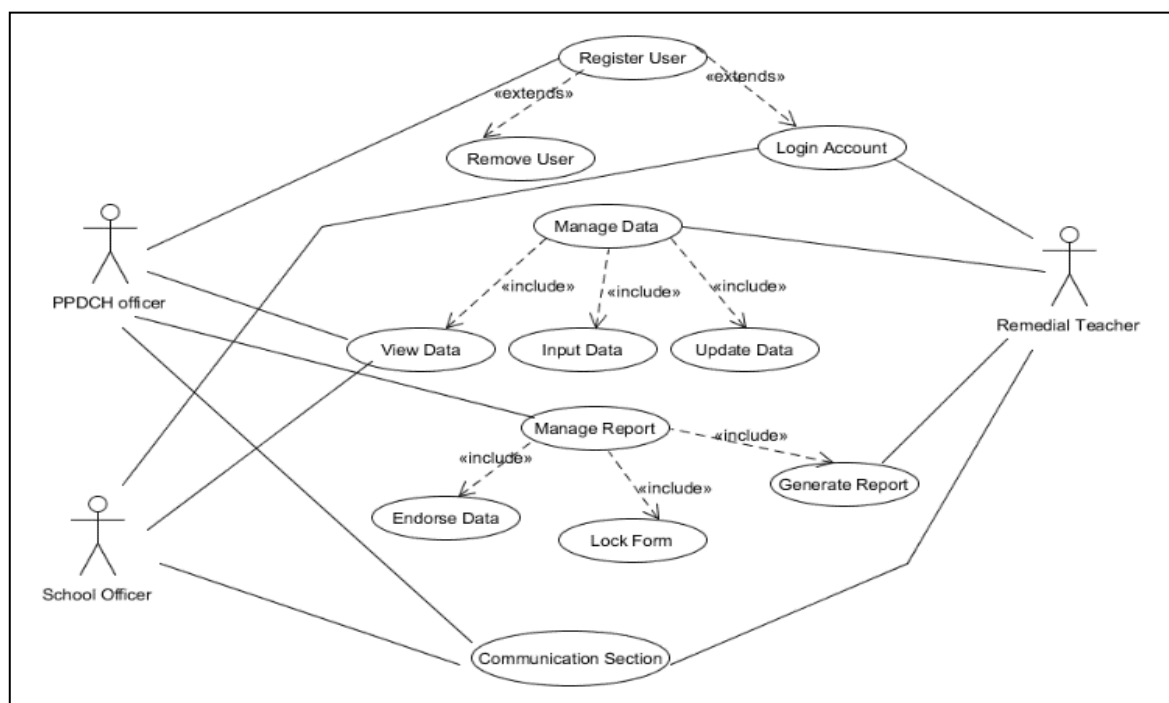
ID	Requirement	Priority
<b>1.</b>	<b>VIEW DATA</b>	
1.1	SPD should allow the school authority to view pupil's data in the respective school.	Mandatory
<b>2.</b>	<b>GENERATE REPORT</b>	
2.1	SPD should allow school authorities to generate pupils' reports.	Mandatory
<b>3.</b>	<b>COMMUNICATION SECTION</b>	
3.1	SPD should allow PPDCH officers to communicate with teachers and school authorities.	Mandatory
3.2	Asking and answering questions can be performed in a discussion forum.	Option

Table 5. The List of Requirements for Remedial Teachers

ID	Requirement	Priority
<b>1.</b>	<b>LOGIN ACCOUNT</b>	
1.1	New teachers can reset account passwords and personal details.	Mandatory
1.2	Existing teachers can log in to their accounts with the correct username and password.	Mandatory
1.3	The error message will be displayed if a user entered the wrong username and password.	Optional
<b>2.</b>	<b>VIEW DATA</b>	
2.1	SPD should allow teachers to view pupils' data of their school.	Mandatory
2.2	SPD should allow the teacher to view pupils' information.	
2.3	SPD should allow the teacher to view pupils' construct achievements.	
<b>3.</b>	<b>INPUT DATA</b>	
3.1	SPD should allow teachers to insert new pupils' information.	Mandatory
3.2	SPD should allow teachers to insert pupils' construct achievements.	Mandatory
<b>4.</b>	<b>UPDATE DATA</b>	
4.1	SPD should allow teachers to update the pupil's information.	Mandatory
4.2	SPD should allow teachers to update the pupil's construct achievements.	Mandatory
<b>5.</b>	<b>GENERATE REPORT</b>	
5.1	SPD should allow teachers to produce reports based on the academic year.	Mandatory
5.2	SPD should produce the report in Microsoft Excel format.	Desirable
<b>6.</b>	<b>COMMUNICATION SECTION</b>	
6.1	SPD should allow teachers to communicate with school authorities and PPDCH Officers.	Optional

<b>6.2</b>	Asking and answering questions can be performed in a discussion forum.	Optional
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The requirements presented in Table 2, Table 3, and Table 4 were translated into the system functionality. The next process is visualizing and modeling the requirements of the app using the appropriate modeling method and tools. In this study, UML was used to visualize and model the requirements. The models used are two behavioral diagrams namely a use case and a class diagram that represents the structural components of the system. The diagrams were drawn using UMLet. Fig. 5 illustrates the use case diagram and the communications between the use cases and the actors (Remedial Teacher, PPDCH Officer, School Officer/Authorities) for the SPD. Furthermore, the four major use cases are Register User, Login, Remove User, Manage Data, Manage Report, and Communication Section. The use case of Manage Data allows users to perform subfunctions including “View Data,” “Input Data,” and “Update Data.” On the other hand, the Manage Report use case allows users to “Endorse Data,” “Lock Form,” and “Generate Report.”



**Figure 5. The Use Case Diagram of The SPD System**

Next, the structural components of SPD are represented in a class diagram as illustrated in Fig. 6. The class diagram shows the attributes and operations of the system. In this study, four main classes were identified namely User, Manage Data, Communication Section, and Manage Report. The interactions between the classes are clearly illustrated by the diagram.

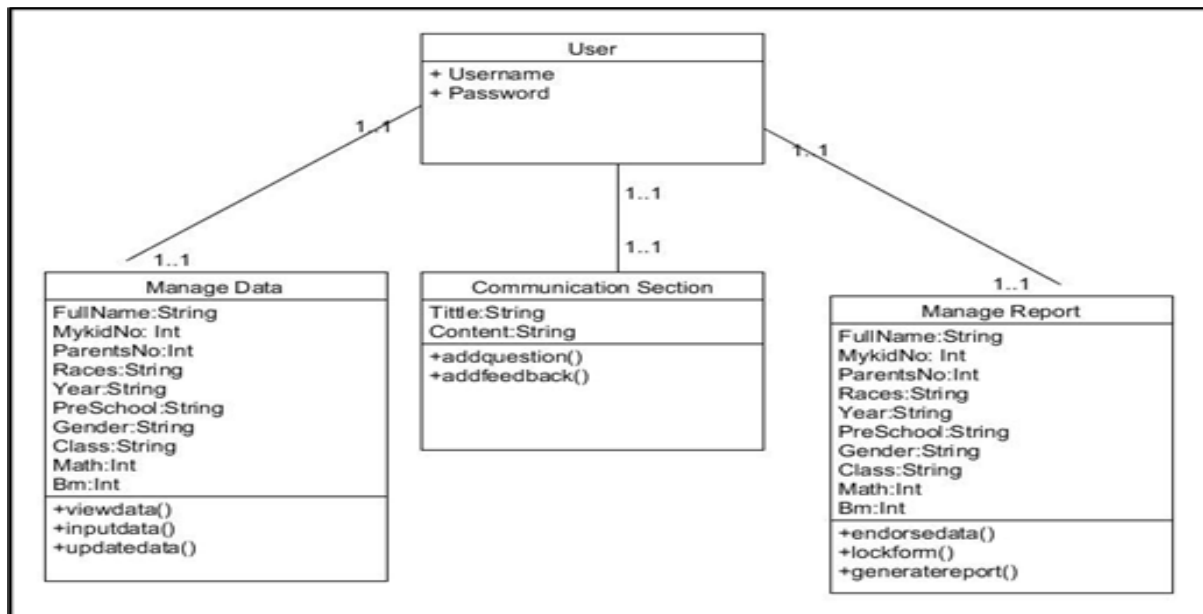


Figure 6. The Class Diagram of SPD

### SDP PROTOTYPING DEVELOPMENT

In this study, a prototype of the web-based application to manage information and data related to remedial education called SPD was developed. It represents the requirements explained in the previous subsection. Software prototyping is a standard method to demonstrate the software requirements so that further comments and suggestions could be obtained from the users based on their experience in interacting with the prototype. The Visual Code Studio was used as the main Integrated Development Environment (IDE) tool and PhpMyadmin was used for database management.

The SPD is a web-based application. Thus, the interfaces are designed based on web interfaces. Figure 4 and Figure 5 are some of the interfaces that have been developed for this system. Figure 4 shows the interface for user login while Figure 5 shows the interface for teachers to enroll new pupils into the system.

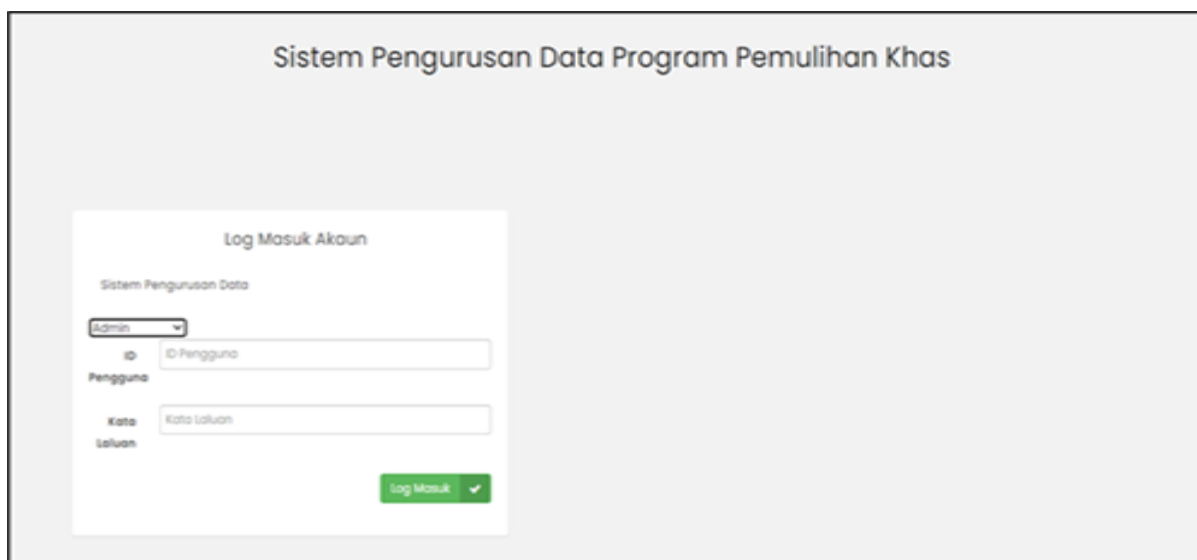


Figure 7. The Interface for Login User

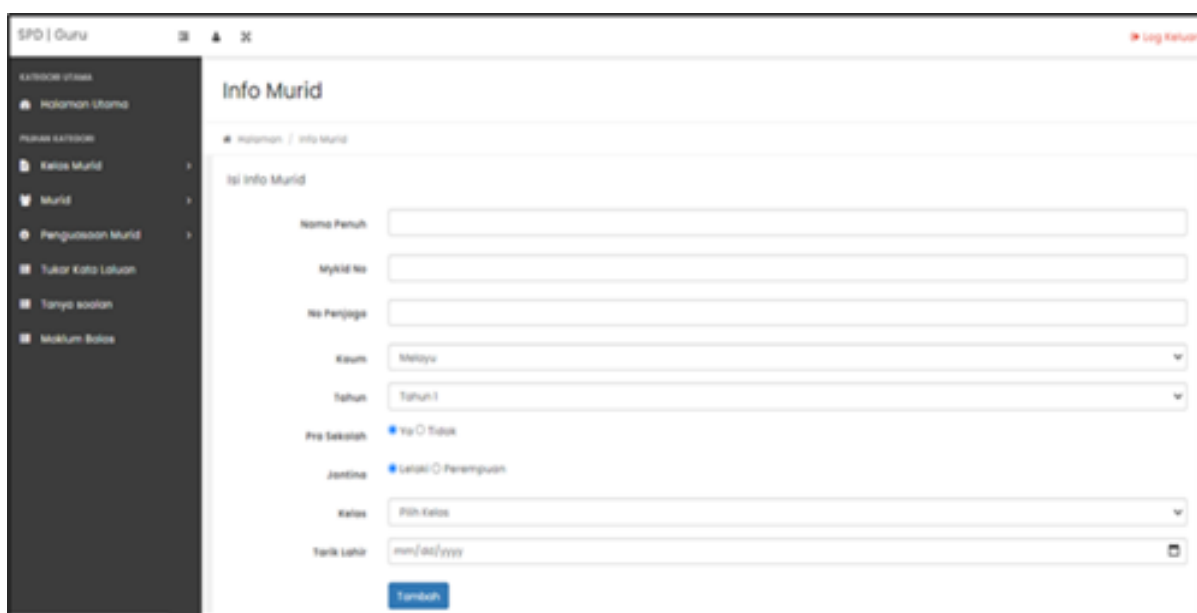


Figure 8. The Interface for Teachers to Enroll New Pupils in The System

### The Evaluation Setting

A usability evaluation was conducted on 30 respondents, consist of 17 remedial teachers, 3 PPDCH officers and 10 school officers. The instruments used for the evaluation comprise the tutorial video, user manual and a post-task questionnaire. The post-task questionnaire consists of 8 items in two sections. Section A asked the user satisfaction based on closed dichotomous questions where only two possible responses are recorded; Yes or No, while section B asked the user suggestions about the system in an open-ended question to collect any feedback or suggestions. The respondents pursued the following steps for the evaluation process: (i) watch the

tutorial video, (ii) read the user manual, and (iii) answer the post-task questionnaire.

### **Usability of SPD**

An analysis was conducted on the respondents' responses in Section A of the post-task questionnaire. The section measures the respondents' perception towards SPD convenience, ease of use and the quality of the system. From the analysis in Table 5, it is clear that the majority of respondents agreed that SPD presents the desired information nicely (n=29, 96.7%), easy to be used (n=28, 93.3%), and properly integrates all the necessary functions (n=27, 90.0%). Moreover, almost all of them would like to use SPD for remedial data management (n=28, 93.3%). A large number of respondents also believe that SPD is more convenient compared to the current practice of remedial data management using MS Excel form (n=22, 73.3%). Nonetheless, SPD still fails to get a total agreement on these aspects of usability evaluation. This indicates that there is plenty of room for improvement before SPD can be fully implemented.

Table 6. The List of Requirement for Remedial Teachers

<b>The post-task questionnaire items</b>	<b>Yes n (%)</b>	<b>No n (%)</b>
<b>Is all information well-presented?</b>	29 (96.7)	1 (3.30)
<b>Is it easy to use this system?</b>	28 (93.30)	2 (6.70)
<b>Are all the functions of this system well integrated?</b>	27 (90.00)	3 (10.00)
<b>Do you prefer to use this system in the future?</b>	28 (93.30)	2 (6.70)
<b>In your opinion, which system is more convenient?</b>	22 (73.30)	8 (26.70)

Furthermore, the outcomes of the evaluation in section B suggested that the website should be upgraded gradually, might add the graph to represent the data and could enhance the website design. In terms of the overall comment, the respondents reported that SPD is user-friendly, straightforward and easy to navigate.

### **CONCLUSION**

Undeniably, remedial data is vital for upper-level management to make the right decision and further come out with a proper strategic plan to improve the quality of remedial education. Therefore, this study described the design and development of the web-based application for remedial education data management, known as SPD.

SPD is a web-based system designed with three different modules for different target users. The three modules are each for remedial teachers, school authorities and PPDCH officers. As the issue of excessive workload among education practitioners becomes more salient nowadays, the remedial data collection procedures should not add salt to the cut (Awang et al.2018). Thus, the

management of remedial data using SPD should be the preferred method to ease their burdens. Remedial data is vital for upper-level management to make the right decision and further come out with a proper strategic plan to improve the quality of remedial education. It is hoped that a systematic data management using SPD would facilitate all stakeholders in PPDCH remedial education program, may they be teachers, education officers, or school authorities. In the future, the functionality of SPD will be expanded by providing more functions according to the client's needs. Overall, this system has been developed in order to improve the efficiency and productivity of education officers, school authorities and teachers to manage information and data related to the remedial program in PPDCH.

However, there is always room for improvement. For future enhancements, this study plans to combine the report of all the schools at the district levels in one Microsoft Excel file, where the users can download and see all the pupils' data in one file. Besides, the future SPD should also allow teachers to upload their evidence in form of all file types to enhance the functionality in managing the data related to a remedial program.

The conclusion must answer the problem coherently. No need to make points, but enough with a paragraph model. No more citing references. In conclusion, it is necessary to convey the deficiencies in this study and suggestions for further research. The conclusion is only enough to answer the problem or research objectives, or it can also produce a new theory/concept based on existing facts/analysis; Don't be impressed to discuss again in the Conclusion section. Acknowledgments please include in the last paragraph and not exaggerate, simply mentioning the parties involved in the research such as funders/sponsors, LPPM, supervisors, etc.

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