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The Development and Application of Digitalized School Management System

Ius Rusnati, Mohammad Fakry Gaffar, Aan Komariah, Rudi Susilana, Dedy Achmad Kurniady

Article Info	Abstract
	This research aims to (1) describe and analyze findings in the existing school management system, (2) develop a digitalized school management system that includes curriculum, student, educator and educational staff, facility and infrastructure, and learning evaluation, and (3) apply a digitalized school management system. ADDIE (Analysis, Design, Development, Implementation and Evaluation) model of Research and Development method was employed for this research. The result shows that manual school management results is a ineffective and inefficient school management. This research has produced a digitalized school management system using Excellence-Based School Management System (EBSM). This system has been tested on a limited basis, the results of which show that schools could adapt to the new system with the support of adequate infrastructure and funding and that SMSBK is a user friendly application.

Introduction

School management is a system of professional, comprehensive, and sustainable school governance that provides various learning opportunities to students without discrimination (Óskarsdóttir et al., 2020;Siu et al., 2019). Facts on the ground show that management is a problem in the administration of education(Mohammadian, 2019;Tokel, 2019). Literature review reveals that most school management is ineffective and inefficient because it is conducted manually in all its aspects, i.e. curriculum, student, educator and educational staff, facility and infrastructure, funding, management, leadership, evaluation, public relations, and cooperation (Shema, 2019). Moreover, school managment is currently experiencing the challenge of globalization and Covid-19 pandemic. Globalization demands that school management produce human resources that are adaptable to the global changes of today (Aliyeva, 2020;Aloraifan, 2021), whereas Covid-19 pandemic has forced 1.6 billion schools to shut downwhile still required to continue the learning process to achieve the goals of schooling (United Nations, 2020).

Considering the important role that school management plays in a nation's human resources development, it is of interest to develop innovations that will make school management more effective and efficient. A number of research suggests that digital innovations have helped schools in initiating an innovation in school management system that improves their quality and performance (Alkaabi, 2018;Ilomäki & Lakkala, 2019;Sahlberg, 2020;Shema, 2019). Digital transformations facilitate the transmision of information through the use of big data. As a collection of a huge amount of heterogeneous information, big data have enabled schools to collect, manage, and preserve rich digital contents for a long period of time(Starkey & Eppel, 2019;Reinders & Mongkut, 2021), despite the difficulties that they still have in integrating the digital technology into their management (Widyanti et al., 2019; Godwin-Jones, 2021). To overcome this problem, schools have to innovate to change the manual management system into a digital, cloud, and cellular-based system to improve the operational efficiency and manage the institution effectively (Eloranta et al., 2020).

The questions of this research are: (1) What are the findings and the analysis of the existing shcool management problem? (2) How is digitalized school management system developed? (3) How is digitalized school management system implemented? And (4) What are the results and the impacts of digitalized school management system?

Plenty of research has been conducted on the use of digital technology at school;(Riswandi, 2017;Dzansi & Amedzo, 2017; Chang et al., 2018; Pettersson, 2018; Andrejevic & Selwyn, 2020; Torres & Giddie, 2020), in the classroom, and among teachers and students(Eady et al., 2017;Taylor & McNair, 2018). However, it is often concentrated only on one or two education and technology phenomena (for example, class case or technical competence of the teachers and students), thereby isolating the learning object from the wider

school context in the school management, and the research was conducted only on one particular level of school (Ilomäki & Lakkala, 2019).

This article proposes an empirical study analysis of school managment, development of a new system of schoool governance that replaces the previoius manual system with the digital one and its implementation in three different levels of school, namely elementary school, junior high school and senior high school supported by a review of 40 identified relevant articles. As stated above, manually conducted school management is a primary problem in the administration of education today; therefore, the development of digitalized school management system will become a significant contribution to the science of school management.

Literature Review
School Management

According to Terry (1960), the function of management begins with planning, which is the process of deciding on the activities to be done and objectives that need to be achieved, how they will be done, and by whom. The planning that has been made needs to be executed, and for this purpose organizing is needed in managing the various available resources. Organizing can be defined as the act of cultivating effective behavioral relations among people so that they can work effectively and efficiently to achieve a set of objectives. The next function is actuating, which can be defined as an attempt to set in motion the available human resources and motivate them to achieve the specified objectives. Actuating can be understood as the implementation of the plan that has been made and prepared. The last function, which is controlling, is required by any organization so that it can run in accordance with its plans and objectives.

In its essence, schools primarily exist for student's learning and contains a set of activities (Engzell et al., 2021). It is a place where students continuously expand their capacity for creating and achieving success; a place where new patterns of thingking, collective aspiration, innovation, and problem solving happen (Dolmark et al., 2021).

School management system is aimed at improving the quality of school's performance (Shema, 2019). In the perspective of educational administration, the concept of school managment represents the process of professional, comprehensive, and sustainable school governance that aims to provide quality educational opportunities suitable with the needs, potential, talent, and interest of the students, and that are relevant to local, national, and international demands, adequate and inclusive, i.e. without discimination, holistically non-fragmentary towardstotal and perfect development. Every level and type of education unit has its own unique function relevant to the development of the students (Oklakorn & Charoenkul, 2017).

Digitalized system

According to Maxwell & McCain (1997), digital technology takes information and breaks it into several small components, changing analogue signals into discrete, digital chunks. Digitalized school management system changes data into information that can be used by the management as input for planning and decision making process in the entire organization (Alkaabi, 2018). Digitalized school management system provides information that is easy to access, read, and in a brief reporting format that has previously been determined. Such format enables the information users to understand the content and apply it in the organization governance and operation (Alkaabi, 2018). Digitalized school management is a modern school management characterized by automation of the work of school divisions and provision of access to modern technology (Boronenko et al., 2020).

Digital leadership

The change in school management system from manual to digital depends considerably on the leader. A study shows that leadership is the most important factor(Tekic & Koroteev, 2019). System reform relies on a leader initiating a reform of school management system (Gierlich-Joas et al., 2020). Digital leadership is leadership in the digital era that makes use of digital technology in a large scale to foster innovation in order to achieve competitiveness and success(Håkansson Lindqvist & Pettersson, 2019;Aldawood et al., 2019;Porfírio et al., 2021;Eberl & Drews, 2021).

Knowledge Management

According to Nonaka (1991, dalam Chew, 2008), knowledge management is crating new knowledge, propagating it throughout the organization, and rapidly transform it into new technolgy and products. At school, knowledge management primarily acts as a prime mover that strengthens and bolsters the institution in performing its functions in order to achieve its visions and misions. In order to apply knowledge management properly in an organizatoin, it is necessary to consider and involve the elements of people as an intellectual asset, processes, and technology support(Gonçalves Costa et al., 2021; Amrahova, 2020).Because knowledge is an essential resource for an organization, knowledge management needs digital innovation in order to be able to speed up the process of creating long term values and direct the organization's strategy towards a new and innovative model (Di Vaio et al., 2021).

Methodology

This research employed the ADDIE model of Research and Development which comprises of five stages, namely Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). This model was chosen because it is more rational and comprehensive compared to other models in terms of its system development steps,

The ADDIE model has been simplified into three stages, namely findings and discussion, development, and implementation. In the findings stage, the researcher conducted an analysis of the school's current system. In the second stage, the researcher developed a new system to replace the old system.The development comprises of philosophical basis, objectives of system development, and system stucture and operation. In the final stage, the system that had been developed was implemented. The implementation comprised of operational design, training, first stage trial, second stage trial, review, and evaluation.

The research was conducted in three private schools of different levels, namely El Fitra Elementary School, El Fitra Junior High School, and El Fitra Senio High School in Indonesia. The schools are located in two separate locations. El Fitra Elementary School occupies a separate location from El Fitra Junior and Senior High Schools, which are located in the sampe place.The instruments in this study were document review, observation, interview and questionnaire.Respondents in this study were Foundation Administrators, Principals of Elementary Schools, Junior and Senior High Schools, Deputy Heads of Schools, Information and Communication Technology Teams and Research and Development Teams.
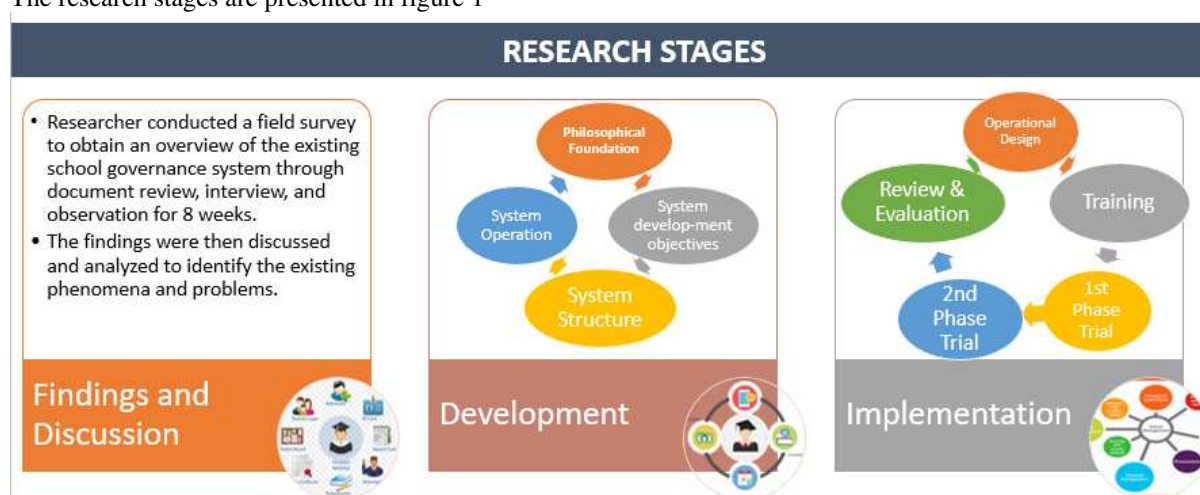
The research stages are presented in figure 1

Figure 1 Research Stages
(Source: Data Processing)

Results And Discussion

The first stage of the research on the current school governance found that the principal of El Fitra Elementary School had already implemented planning, organizing, deployment, control, and evaluation.The components being managed include curriculum, students, educators and educational staff, facilities and infrastructure, management, funding, evaluation, leadership, public relations and cooperation. The school management ran properly in accordance with standard operating procedures (SOP) set by the foundation. However, because all the components were managed manually, there were problems of high cost of reproduction in the drafting of curriculum, access to the curriculum by teachers and relevant parties, and optimum document usability. Manual administration and documentation had made data on students, educators and educational staff, facility and infrastructure, public relations and cooperation scattered in different places and difficult to access so that they were nor readily available to processed into information. This hampered the decision making process by the school management who heavily relied on the quality of information available to them.

The principal of El Fitra Junior High School had already implemented planning, organizing, deployment, control, and evaluation.The components being managed include curriculum, students, educators and educational staff, facilities and infrastructure, management, funding, evaluation, leadership, public relations and cooperation. El Fitra Junior High School management had not run effectively and efficiently because some elements were still managed manually and it had its own building only in 2020. A lot of its data were still in paper and ink making it prone to damage, scattered, difficul to access or even got missing. This had hampered the running of the school organization.

The principal of El Fitra Senior High School had already implemented planning, organizing, deployment, control, and evaluation. The components being managed include curriculum, students, educators

and educational staff, facilities and infrastructure, management, funding, evaluation, leadership, public relations and cooperation. The management of El Fitra Senior High School had not run effectively and efficiently because all elements were still managed manually and it had its own building only in 2020. El Fitra Senior High School moved places serveral times and some of its administrative data were scattered, damaged, or lost. Records of facilities and infrastructure were unclear and some were even missing. Fortunately, thanks to the management team's persitence, hard work, and solid cooperation, Al Fitra Senior High School had managed to produce graduates who were able to continue their studies to state and private univiersities.

The researcher then conducted analysis of the findings against relevant literature. A study by Riswandi (2017) andThanon et al., (2020) the information management system that created top schools based on National Education Standard. A study by Yang et al., (2020) and Balkaya & Akkucuk, (2021) showed that school information management system improved the effectiveness and efficiency by cutting down the time and providing alternative solution to complicated problems.Abu-Khadra, Barqawi, & Alramahi in (Alkaabi, 2018) studied an integrated information system to facilitate timely and effective communication among stakeholders in an organization.Mehrolia et al., (2021)stated that digital technology was very useful in helping the school management acheive its main objective of improving learning quality. Prananosa et al. (2019) developed a database model of school information system management to meet the needs of divergent school data.

The results of literature review suggests that digital innovations could become a solution to the problems found in the findings stage. This leads to the next stage of this research, namely developing a new system of digitalized school management.The philosophical basis for the sistem development is founded on a learning process-based school management that aims at creating learners who are active in developing their potential to achieve spiritual growth, self-control, intellect, and good character, and attain skills (such as communication, collaboration, critical thingking, and creativity) that they, their community, and their nation will need in the future. The development of a digitalized school management system is aimed at accomodating various data processing needs. The data processing outcome can be in the form of school regular reports that are accessible and easy to understand to be the basis for decision making so that school management can be effective and efficient.

The next phase of the system development is creating the system's structure or design that consists of the architecture of school mangement elements that will be developed, the descriptions of activities in every element, and the flow of activities and the data related to them. The elements developed in this research are limited only on the essential elements, namely curriculum, student's service and administration, facilities and infrastructure, and learning evaluation (figure 2).

Figure 2 Fitures of Digitalized School Management System

The system design is represented trough use case diagram. It contains features that can be accessed by every actor and is designed according to predefined actors, namely super admin, school administrator, and users. Super admin is an actor with full access to school management in general. It consists of the Foundation and Operator Admin. Figure 3 shows Super Admin use case diagram.
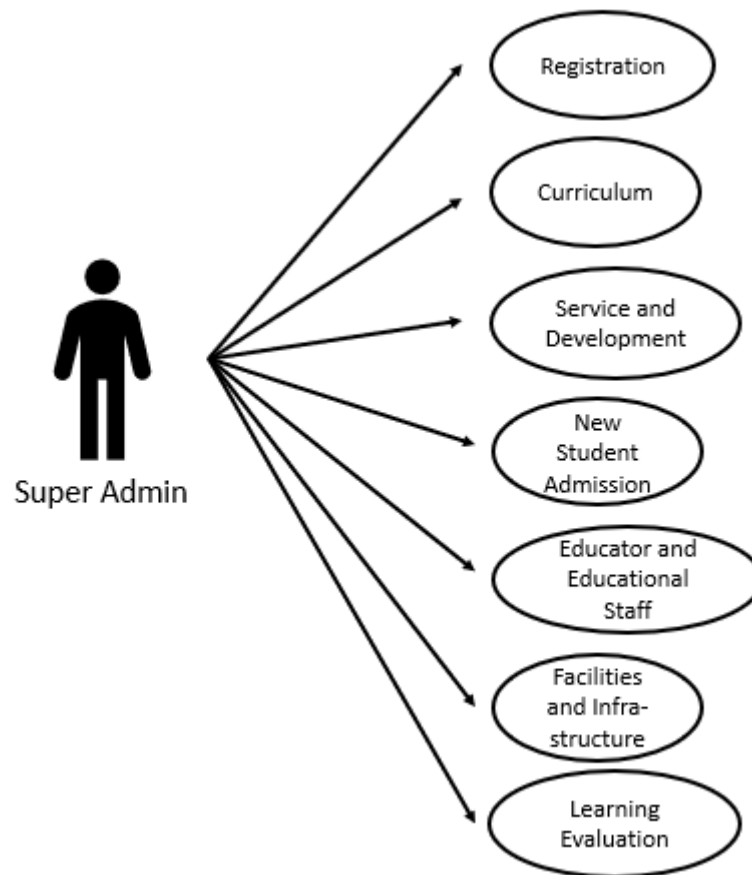

Figure 3 Super Admin Use Case Diagram

School administrator is defined as an actor who can do school operational activities, namely the principal, treasurer, administration staff, and teachers. Figure 4 shows school administrator user case.
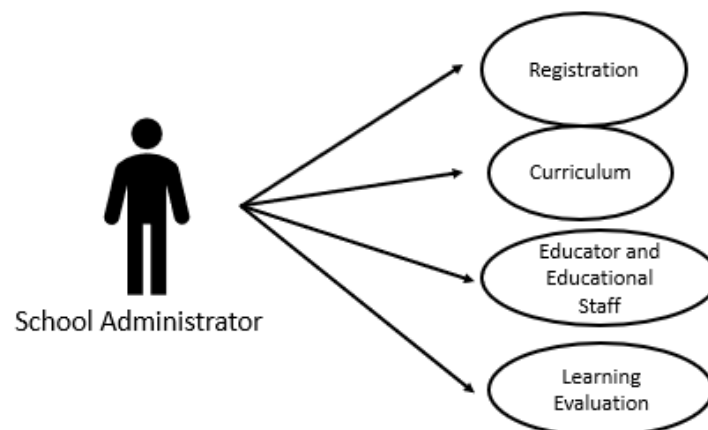
Figure 4 Diagram of School Administrator User Case

User is an actor that can access school services, namely the student or student's parents.
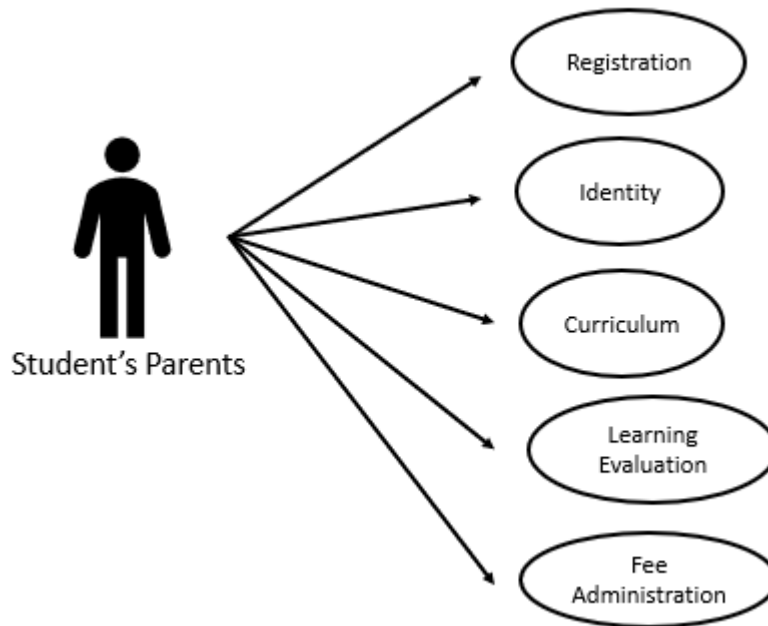
Figure 5 Diagram of User Use Case

Use case for student's parents has general features that can be accessed by students. The curriculum feature student's parents can access schedules, subjects, self-development and extracurricular activities. Learning evaluation feature provides parents with information about achievement, guidance and counseling records, grade history, report book, and school exam and national exam grades. School fee administration provides information about school fee arrears.

After the design of the system structure was completed, the next step was identifying an application program that would be suitable for the system structure that had been designed. The SMSBK application was chosen because it was suitable for the completed design and had been patented. The researcher has obtained legal license from the chairperson of the SMSBK developer team to use it for this research.

To describe how SMSBK works and how the features are accessed by each actor, the researcher used activity diagram. The super admin, which consists of the Foundation, research and development, and operator admin, can process, read, add, change, or delete data from each main feature. The complete activity diagram for the super admin is described in figure 6.
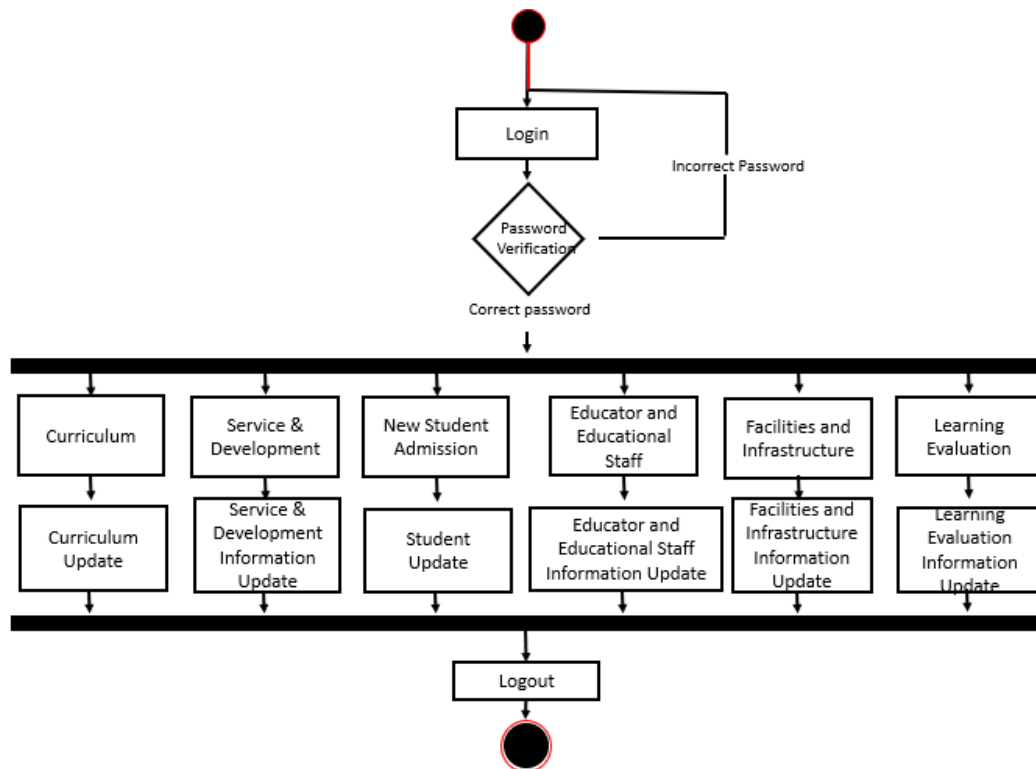
Figure 6 Activity Diagram for Super Admin

The process of every feature described in super admin use case is detailed in the activity diagram, namely access to update data on every feature. Other actors, i.e. school administrator can read the information and update data on learning evaluation feature, whereas the student's parents can read information of the teaching and learning process.

School administrator, which consists of principal, treasurer, administrative staff, and teachers can access information on curriculum, educators and educational staff. The diagram is presented in figure 7.
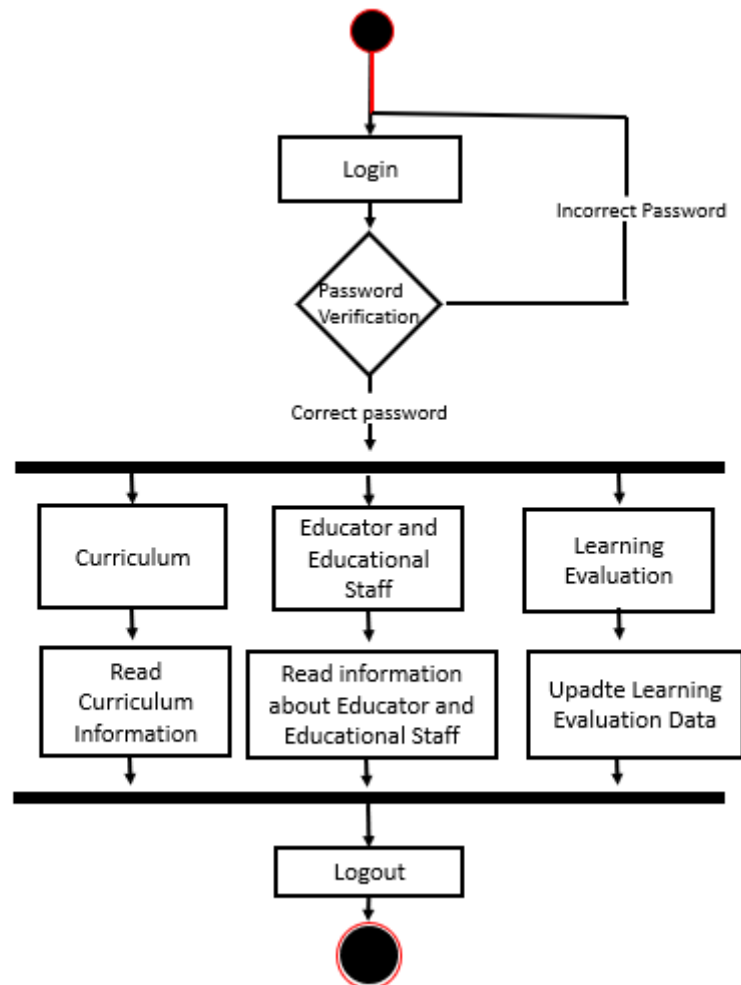
Figure 7 Activity Diagram for School Administrator

Teachers can update and add data on learning evaluation to be accessed by student's parents. User, in this case student or the student's parents, can access the system to receive information about the student's identity, curriculum, learning evaluation, and school fee administration. To change the information on the above features, the student's parents must communicate with the actor who has access to make the change, namely the school administrator or super admin. User's activity diagram is presented in figure 8.
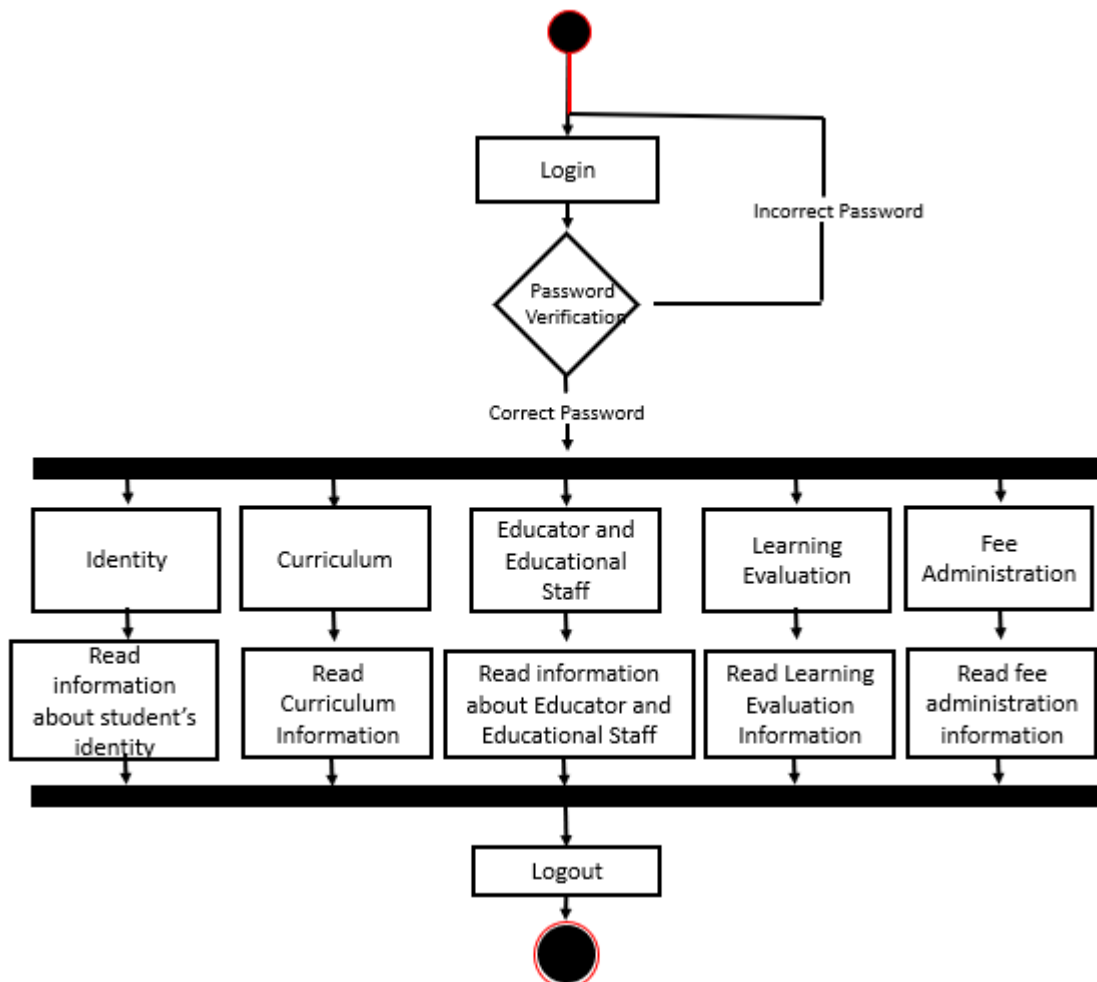
Figure 8 User's Activity Diagram

The final stage in this research is implementation. It begins with the operational design which consists of (1) preparation of the elements to be tried; (2) infrastructure inspection (software, hardware, brainware); (3) budget checking for infrastructure needs; (4) checking readiness of data of curriculum, student, educator and educational staff, facilities and infrastructure, and evaluation; (5) collecting data on personnel involved from Al Fitra Elementary School, Junior High School, and Senior High School; and (6) preparing schedules, timeline, and briefing.

The next activity is the trial. Before the trial, training was conducted to help all users understand the urgency of the new system for the school managment, introduce and learn how to operate the system, understand the role of data, system, and accurate procedures in fulfilling the needs of user, and procedures to manage information. There are two stages to the trial: stage one and stage two.

The first stage was the initation of the system by the operators of Elementary School, Junior High School, and Senior High School. The implementation flow of system initiation is presented in figure 9.
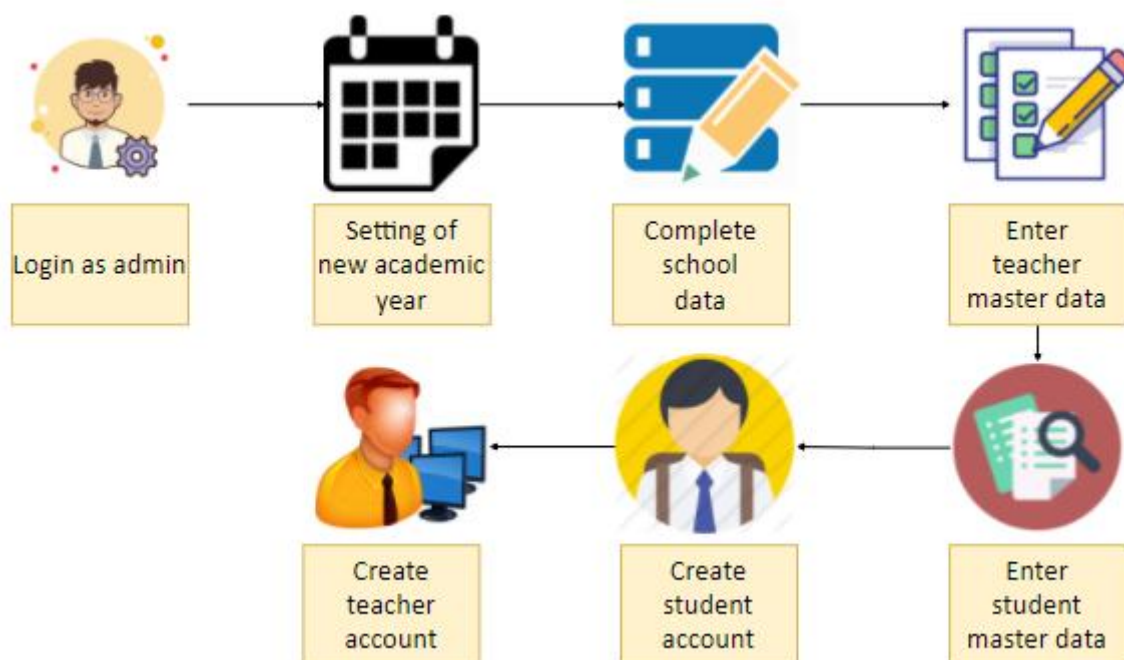
Figure 9 Sistem initiation by school operators

In the login menu, admin enters a user name and password of their account. If the user name or password is not registered, a message of error will appear, "Sorry, user name and password do not match!" Correct registered user name and password will open the admin menu. The admin will then set the academi year by pressing the "TA-Semester" button. The screen will display school setting form to set the academic year and school emester. The Completing School Data submenu displays detailed information about the school, which include NSS (School Statistic Number), name of school, address, telephone number, dan regency/municpality where the school is located. The admin choose the academic year and the active semeter, namely 2020-2021 and even sementer or semester 2, input the school data, the school photograph and logo. After the update all users under the school login will have the data of 2020-2021 academic year and semester 2. After setting the system, admin will perform data entry from the existing *Dapodik* (key education data) by importing them to the system in cvs or excell format. The next step is to input student master data. There is an import button in the student identity section. In the process of importing the student data, the curriculum design is chosen, namely the 2013 Curriculum. The PTK (educator and educational staff) will use the NIK (National Resident Identity Number) for their accounts, whereas the students will use NISN (National Student Registration Number). The system will automatically generate accounts for all students and educators and educational staff.

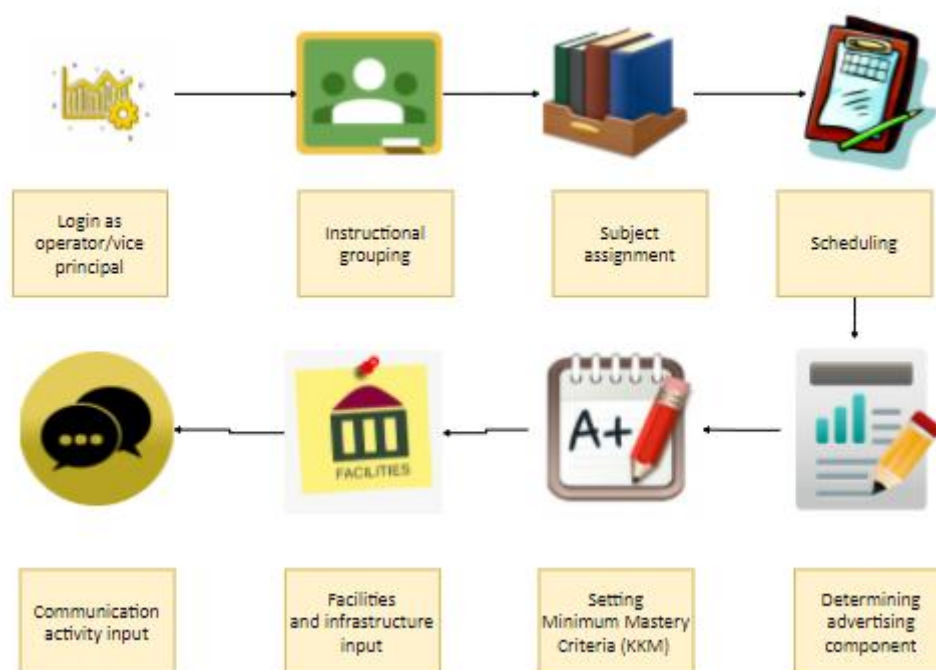The next stage is the operational stage by the vice principal. The flow is described in figure 10.

Figure 10 Vice principal operational flow

The vice principal for curriculum affairs is in charge of determining instructional grouping for the students and assigning active students to the appropriate instructional grouping.She will then assign the person in charge of the subject, prepare schedule, determine school-based grading components and values and school-based minimum mastery criteria.

The vice principal for facilities and infrastructure will input the Elementary School and Junior High Schoolfacilities and infrastucture data(for Senior High School facilities the data are inputted by the person in charge of the asset). Vice principal for public relations will input communication activities.

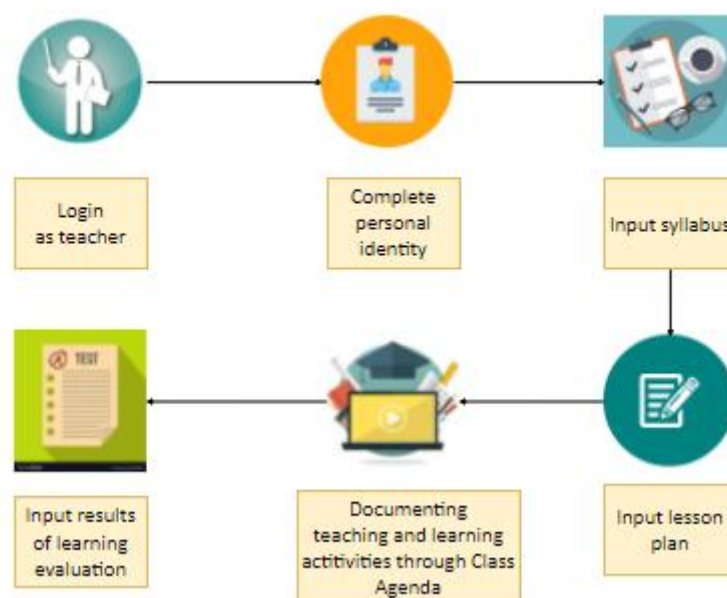The next stage is performed by the educators, as presented in figure 11.

Figure 11 Teacher/Educator Operational Flow

Educator who have completed their ID and personal data, upload syllabus and lesson plans, document the teaching and learning process that takes place in the classroom, and input the learning evaluation results.

Figures 12 until 14 are the general features of SMSBK for Elementary School, Junior High School, and Senior High School.

Figure 12 Main Menu of EBSMS for Elementary School

Figure 13 Main Menu of EBSMS for Junior High School

Figure 14 Main Menu of EBSMS for Senior High School

The trial was conducted on the features of curriculum, student service and development, selection and admission of new students (PPDB), educator and educational staff (PTK), facilities and infrastructure, and learning evaluation.

The curriculum feature consists of the following subfeatures: (1) curriculum structure; (2) syllabus; (3) thematic sysllabus; (4) syllabus availability; (5) lesson plan; (6) lesson plan availabilty; (7) assignment of class subject teacher; (8) schedule; (9) curriculum document; (10) class agenda; (11) attendance record; (12) extracurricular activities; and (13) self-development.

Student service and development feature consists of (1) student identity; (2) student classification and according to gender proportion; (3) student classification according to parents' job and income; (4) student classification according to hobby, talent, and interest; (5) student classification according to student religious proportion; (6) number of student recapitulation; (7) student condition; (8) GC records; (9) student turnover; (10) student instructional grouping; (11) continuing rate; (12) high-achiever students; (13) student organization; (14) finding and coaching students with talents.

The selection and admission of new students feature has the following sub-features: (1) general information; (2) registration information; (3) registration form; (4) list of applicants; (5) new student admission results; (6) new student registration; (7) instructional grouping of new students.

The educator and educational staff feature consist of the following sub-features: (1) recruitment; (2) educator and educational staff identity; (3) education qualification; (4) educator and educational staff competence; (5) assignment and teaching load distribution; (6) performance; (7) continuing professional development; (8) welfare of educator and educational staff.

The facility and infrastructure feature is used to record and trace school inventory. It comprises of the following sub-features: (1) classroom; (2) laboratory, workshop and studio; (3) educational equipment; (4) information and communication technology; (5) library; (6) sports facilities; (7) audiorium; (8) mosque/prayer room; (9) toilet; (10) cafetaria/kiosk; (11) electricity and plumbing; (12) storage; (13) security system.

The learning evaluation feature has the following sub-features: (1) Minimum mastery criteria (KKM); (2) descriptive grading; (3) grading components; (4) student ranking; (5) class evaluation; (6) detailed class evaluation; (7) report book; (8) school-based examination; (9) national examination; (10) results of national examination recapitulation; (11) recapitulation of graduates; (12) national examination best grades.

Througout the trial phase, advising by the reviewer was conducted online through Zoom online meeting.The final stage of the implementation is review and evaluation. The review and evaluation of the first stage trial found a problem in the schedule preparation. However, the system initiation for elementary school, junior high school, and senior high school was by and large completed. Review and evaluation of the first stage trial became the basis for the enhacement and improvement of the second stage implementation trial. In the second stage trial, all users explored the features which had not been inputted in the first stage, such as scheduling, grading, lesson plan, and syllabus.

Results of the final review and evaluation by the reviewer show that in general the elementary school, junior high school, and senior high school could follow the new system as evidenced by the completion of the EBSMS components shown in Table 1.

Table 1

Recapitulation of SMSBK component completion in Elementary School, Junior High School, and Senior High School

No.	Components	Elementary School		Junior High School		Senior High School	
		Completed	Not completed	Completed	Not Completed	Completed	Not Completed
1	Curriculum	20	5	18	4	12	10
2	Student Service and Development	8	9	11	6	10	7
3	New Student Admission	3	4	3	4	3	4
4	Educator and Educational Staff	10	11	12	9	12	9
5	Education Facilities & Infrastructure	10	3	10	3	2	11
6	Learning Evaluation	11	2	9	4	9	4
	Total Completion	**62**	**34**	**63**	**30**	**48**	**45**
	Completion Percentage	**64,58%**		**67,74%**		**51,61%**	

Source: Data Processing

Chart 1

Recapitulation of EBSMS Menu Completion
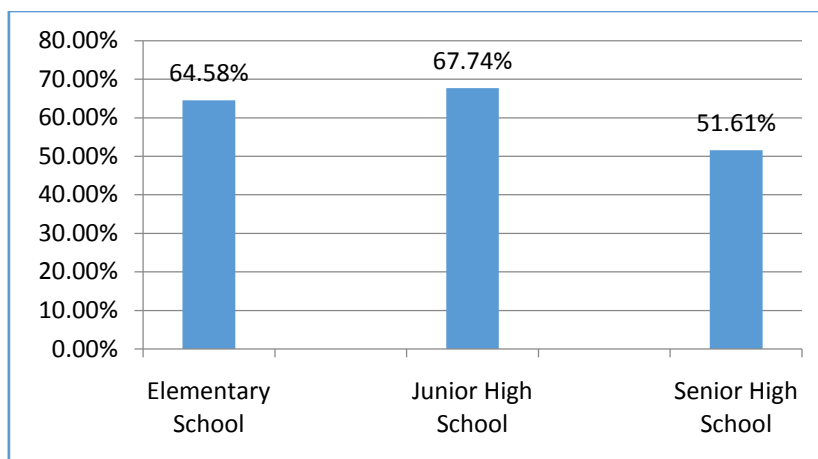
Source: Results of data processing

Table 1 and Chart 1 show that El Fitra Junior High School ranks first in the completion of EBSMS components. El Fitra Elementary School ranks second and El Fitra Senior High School ranks last. The level of percentage achieved by El Fitra Elementary School and Junior High School is attributable to the highly intensive organizing, mobilizing, controlling, and supervising efforts made by the schools' management in the second stage trial. El Fitra Senior High School was left behind in the third place because ofthe limited personnel involved and because it did not have its own Student Master Data *(Dapodik)* (it is still affiliated to another school).

To evaluate the results and impacts of the implementation of the digitalized school management system, questionnaires and interviews were used. Responses to the questionnaires indicate that respondents agreed to the statements thatthe implementation of SMSBK application (1) improved the management quality (100%); (2) made it easier to control the unfinished work (94%); (3) exedited reporting processes (94%); (4) minimized school management data loss (100%); (5) improved teacher's productivity and performance; and (6) helped get more work done than it would normally do (88%). In general, SMSBK was also considered (7) easy to use (user friendly) (94%) and (8) useful for the teachers in managing the school affairs (94%).

The results of the interviews suggest that the digitalized school management system through SMSBK application facilitated the acquisition of timely and integrated data relevant to the school's needs. The SMSBK application is easy to use and makes school management effective and efficient because it facilitates the management of a large amount of documents, makes it easier to prepare month reports and monitor the performance of El Fitra Elementary School, Junior High School, and Senior High School units.

CONCLUSIONS

This research is comprised of three stages, namely findings and discussion, system development, and system implementation. From the findings and discussion stage it can be concluded that the management of El Fitra Elementary School, Junior High School, and Senior High School, which include planning, organizing, mobilizing, and controlling of the elements of curriculum, student, educator and eduational staff, facilities and infrastructure, leadership, management, evaluation, public relations, and national and international cooperations, was still done manually and had resulted in various problems of ineffective and inefficient school management.

In the development stage, design of digitalized school management system was made by considering the philosophical foundation, the objective, and the structure of the system. An application was then chosen to accomodate the system design for use in the elementary school, junior high school, and senior high school. Excellence-based School Management System or called SMSBK was chosen because the application was suitable with the design that had been made, could be used in elementary school, junior high school, and senior high school levels, and has had a patent.

In the implementation stage, the operational design (which include infrastructure preparation, funding, personnel, schedule, and briefing) was prepared, and training and first and second phase trial were conducted. In general, the results of the system implementation was considered successful and the system received very positive feedback from all users in its ability to bring about efficient and effective school management.The system implementation owed its success to the support of adequate infrastructure, the comprehensiveness and user-friendliness of the SMSBK application, the understanding of the system by all users involved, and the facilitators who had managed to build an interactive and communicative atmosphere.The digitalization of school management system has in general improved the schools' management quality, made it easier for all users to do their jobs according their respective levels and positions, and store the school's database neatly and securely.

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Author Information	
Ius Rusnati Universitas Pendidikan Indonesia, Indonesia	**Mohammad Fakry Gaffar** Universitas Pendidikan Indonesia, Indonesia
Aan Komariah Universitas Pendidikan Indonesia, Indonesia	**Rudi Susilana** Universitas Pendidikan Indonesia, Indonesia
Dedy Achmad Kurniady Universitas Pendidikan Indonesia, Indonesia	