Enhancing the Mahaguru E-learning Application for Elementary School Students using Chatbot and Gamification

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Abstract

Elementary school is the most basic level of formal education in Indonesia, which is taken from grade 1 to grade 6. The number of elementary school students in Indonesia in the 2019–2020 academic year is 25.2 million. This level requires face-to-face learning between students and teachers. However, this became difficult to do during the COVID-19 pandemic. More students were required to study independently. For this reason, learning media are needed that can support students in learning independently. This study provides new ideas for implementing learning systems through e-learning applications. This system applies chatbots and gamification to e-learning to help fulfill the learning principles mentioned above for elementary school students, which can help the teacher's role as an educator, generate learning motivation, foster an active attitude, and foster a competitive spirit in the distance learning system. With the E-Learning application featuring chatbots and gamification, students can learn interactively and competitively by utilizing gamification. They also get personal guidance in assisting the learning process independently by using chatbots, so the learning process in elementary schools can run more effectively and efficiently.

Keywords: Elementary school; E-learning “Mahaguru” ; Chatbot; Gamification

1. Introduction

Elementary school is the most basic level of formal education in Indonesia (Aka, 2018). Elementary school is taken within 6 years, starting from grade 1 to grade 6 (Hayati, Neviyarn, & Irdamurni, 2021). The number of Elementary school students in Indonesia in the 2019/2020 school year was 25.2 million. This number is quite large so the need for facilities, infrastructure, and innovation in the world of education is very important. This aims to always improve the quality in the world of education, especially in Indonesia (Rahayu & Haq, 2021).

According to Indonesian Law No. 20 of 2003 concerning the National Education System states that learning is the process of interacting students with educators and learning resources in a learning environment (Samnisar, 2019). Unfortunately, students and teachers are currently unable to hold a direct or face-to-face learning process due to the Covid-19 outbreak. Then, according to Indonesian Law No. 20 of 2003 concerning the National Education System, Distance Learning is education where students are separated from educators and learning uses various learning resources through communication technology, information, and other media (Gunawan, 2020). With Distance Learning, students are required to be more independent in terms of learning facilities and infrastructure (Mar’ah, Rusilowati, & Sumarni, 2020).

Nowadays, computer technology is developing rapidly, and has also become a vital part of daily life (Ngafifi, 2018). The role of computer technology is also starting to be needed by various other disciplines. In the field of education, computer technology is one of the solutions to problems in the field of education (Yoga, 2018). In the process of teaching students, teachers must prepare strategies that can help students learn, understand, and memorize the material provided such as exams and homework (Purba, Yahya, &

Nurbaiti, 2021). The media used is usually a web-based or mobile e-learning. E-learning is an electronic-based educational process, one of the media used is a computer network (Elyas, 2018). With the development of e-learning, it can allow the learning process to be done independently without being bound by space and time (Arianto, 2018).

Among the levels of education in Indonesia, namely elementary school, junior high school, and senior high school, elementary school students are the level that needs the most assistance in learning (Hartono, 2018). All of this is because elementary school students are still at a young age and growing period. Now that the distance learning system is in place, the role of the teacher as a source of motivation has greatly decreased (Suputra, Budasi, & Paramarta, 2021). This is due to the reduced face-to-face portion in the learning process. Another principle is the principle of social relationships, where this principle seeks socialization in growing children who are much influenced by the social environment (Lisetyati, Suwartiningsih, & Kudubun, 2021).

A chatbot is a virtual robotic chat service with artificial intelligence that mimics human conversation through text chat, voicemail, or both. Chabot's role in education is quite numerous. Namely, among others: learning assistants, teaching assistants, learning evaluation tools, and guides for prospective students. In this research, the use of chatbot will be associated with the function of learning assistant. Where due to distance learning, the role of the teacher is reduced. Chatbot is one of the solutions that help children, especially elementary school students, learn as learning assistants (Nugraha, Masnitab, & Kurniawati, 2022).

The concept of gamification is the use of game planning elements in applications or systems that have nothing to do with games. This will certainly provide motivation for elementary school students in learning the modules that they will learn according to the level determined by the educator. Examples of the use of gamification are follower systems, leaderboards, and achievements. These game elements will provide motivation and foster a spirit of competition among students.

Based on the problems that have been described, a learning system or elearning for elementary school students is needed to help fulfill the learning principles of elementary school students above, which can help the role of teachers as educators, bring up learning motivation, foster an active, social, and competitive spirit in the Distance Learning system (Durahman & Nugraha, 2022).

In line with existing government policies and considering various needs in the community, the purpose of developing this software is to design and build an elearning system for elementary school students using chatbot technology, and gamification. The benefits provided for users with the development of this software are Students can save costs because they do not need a lot of devices in accessing e-learning, Students can learn interactively and competitively by utilizing gamification (leaderboard, achievement, follower) and Students can also provide a knowledge base for chatbot, in order to contribute to the world of elementary education in Indonesia.

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2. Analysis and Design

A. Analysis

There are several stages of analysis carried out in the design of this research, the following are details of the process at this stage:

1) Identification Process

This process explains how to identify the causes of problems by identifying problems, identifying actors and identifying data

a. Identifying Problems

Problem identification is the first step in designing and developing a system. The identification process is based on three things. The first is the analysis of existing problems/phenomena, the second is the analysis of the impact caused by the problem/phenomenon and the last is the analysis of the solution to the problem / phenomenon and the impact caused. The solution will be applied to the functional requirements in the "Mahaguru" application. The identification of problems in the development of the "Magaguru" application is as follows:

Table 1 Identifying Problems

#	Problem	Impact	Solution
1.	When a student experiences learning difficulties, they will generally ask their parents or attend tutoring, but there are students whose parents are busy and cannot afford to attend tutoring.	The impact can vary, ranging from students not understanding a subject, poor test scores, and declining achievement.	Create a system that presents a wide variety of learning resource materials that are in accordance with the current class and curriculum. The materials can be accessed by anyone for free and can be used as a reference for

#	Problem	Impact	Solution
			self-study at home.
2.	The current Distance Learning Policy causes the role of teachers to guide students to be reduced, due to the lack of face-to-face portions in the learning process, teachers as educators will experience difficulties in guiding students intensively.	Students lack a lot of learning support, thus making students less able to follow the lesson	Creating a system that can help students get personalized guidance in assisting the distance learning process, students use chatbots. Students can also teach something knowledge to the chatbot to add to the knowledge base of the chatbot itself, so that students also contribute to the world of education in Indonesia.
3.	The distance learning policy also restricts students from meeting friends or other students.	Reducing the competitive spirit of students because they never meet their peers.	Creating an elearning system with gamification methods such as followers, leaderboards, achievements, and games based on practice questions. This system can foster students' competitive spirit because they feel they are competing with their friends.

b. Identifying Actors

Actor identification is the process of analyzing users on a system. This process is very important to know who uses a system. In "Mahaguru" elearning, there are two actors, namely users (elementary school students) and admin (team "Mahaguru"). The identification of actors in the "Magaguru" application development is as follows:

Table 2 Identifying Actors

#	Actor	Description
1.	Users	Users are elementary school students who learn through "Mahaguru" elearning.
2.	Admin	Admin is the "Mahaguru" team in charge of managing user data, subject data, exam data, etc. for the user's learning process.

c. Identifying Data

This data identification involves what data needs are used in the learning process on the "Mahaguru" e-learning. The required data are:

Table 3 Identifying Data

#	Master Data	Transaction Data
1.	Friends	Users
2.	Lesson	Achievements
3.	Chapter	Leagues
4.	Course	
5.	Exams	
6.	Quizzes	
7.	Education	
8.	Knowledge Base Chatbot	

2) Analysis Process

After carrying out all the identification processes, the next analysis is carried out which includes functional requirements analysis and system requirements analysis. The following is a detailed explanation.

a. Functional Requirements Analysis

Functional requirements analysis is the functional needs of users that exist in a system. The functional identification of "Mahaguru" elearning is as follows:

Table 4 Functional Requirements Analysis

#	Actor	Functional	Description
1.	Users	Register	Is the process of registering into the system
2.	Users	Login	Is the process to enter the system
3.	Users	Manage profile data	A process for managing profile data
4.	Users	Accessing subject-specific learning materials	It is a process to learn independently by reading a material
5.	Users	Doing practice questions	It is a process to do a test or quiz after reading the material
6.	Users	Ask to the chatbot	This is the process of consulting with the "Mahaguru" chatbot.
7.	Users	Teaching a chatbot	This is the process of teaching the " Mahaguru " chatbot.

#	Actor	Functional	Description
8.	Users	View user leaderboards by league	Is a process to see the ranking of student activeness based on the points each student has.
9.	Users	Getting rewarded (achievement) after doing an accomplishment	Is a material data management process that includes entering data, viewing data, changing data, deleting data, and searching for data carried out by the admin.
10.	Users	Manage friend data	It is a process of managing friend data which includes entering data, viewing data, changing data, deleting data, and searching data.
11.	Admin	Manage student data	It is the process of managing student data which includes entering data, viewing data, changing data, deleting data, and searching data.
12.	Admin	Manage material data	This is the process of managing learning material data which includes entering data, viewing data, and managing learning material data which includes entering data, viewing data,
13.	Admin	Manage question exercise data	It is the process of managing question exercise data which includes entering data, viewing data, changing data, deleting data, and searching data.

b. System Requirements Analysis

This process serves to determine the needs of the system in order to reach the goal, design a system that is aligned with the program design, and also prepare documentation in each coding activity. Below are the details of the system requirements analysis.

Table 5 System Requirements Analysis

Software Requirements	Hardware Requirements
Web server Nginx	Minimum OS Lolipop
Node	Random Access Memory (RAM) Minimum sebesar 2 Gigabyte (Gb).
Python	
Text Editor (VS Code)	
Post Man	

B. Design

The next step of this research after the analysis stage is the design stage which includes creating a Conceptual Data Model and Physical Data Model. The following below is the Conceptual Data Model (CDM) and Physical Data Model (PDM) in this study.

CDM describes the overall concept of the database structure designed for a system. In the CDM in this study there are 10 entities namely Friends, Lesson, Chapter, Course, Exams, Quizzes, Education, Users, Achievements, and Leagues. With details of the relationship, namely Leagues one to many with Users, Achievement many to many with Users, Education one to many with Users, Education one to Many with Course, Course one to Many with Chapters, Chapters one to Many with Lessons, Lessons one to Many with Quizzes, Quizzes many to Many with Users, Lessons many to Many with Users, Friends many to Many with Users, Exams many to Many with Users, and Chapters one to Many with Exams.

PDM describes in detail about the designed database which is derived from the CDM mapping. The PDM clearly illustrates the relationship between tables along with the primary key and foreign key of each table. The results of PDM in this study amounted to 14 tables which included 4 additional tables from the results of many to many relationships in the Achievement table with Users resulting in My Achievement, Lessons with Users resulting in My Lessons, Quizzes with Users resulting in My Quizzes, and Exams with Users resulting in My Exams.

3. Implementation and Discussion

A. Implementation

The implementation stage is the stage of software creation, a continuation stage of the analysis and design stage. This stage is the stage where the system is ready to be operated, which consists of an explanation of the implementation environment, and program implementation. To support the application that is applied to elementary schools, then in this case using hardware and software that supports the development of support in the development of the application "Mahaguru". Below are the details of the implementation stage.

1) Register and Login Page

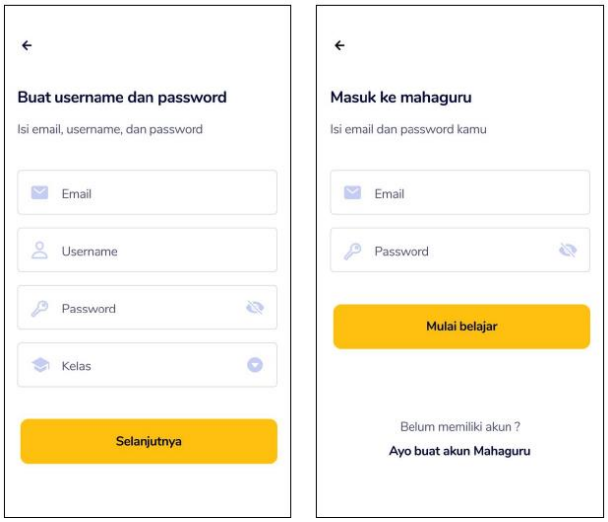

Figure 1 Register and Login Page

The registration page is the page where elementary students can register for an account to access the "Mahaguru" elearning, while the login page is the page where elementary students can log in to access the "Mahaguru" elearning.

2) Profile dan Leaderboard Page

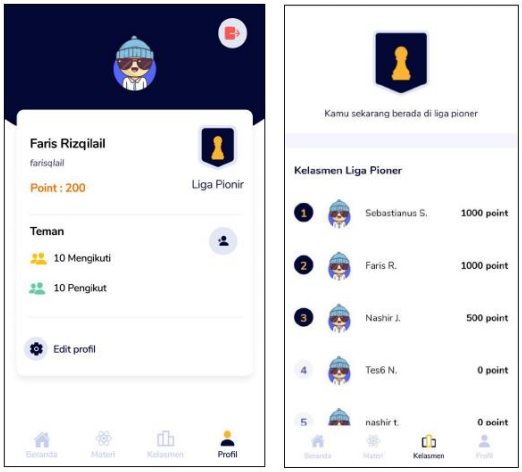

Figure 2 Profile dan Leaderboard Page

The profile page is a page that shows the personal data of the student who is currently logged in. In the profile page there is name data, points, and the number of followers - following. On the profile page, users can also change data related to personal data. For example, name, email, username, and date of birth data.

The leaderboard page is a page that shows the ranking of all users based on the number of points owned by each student. Students can get points from reading materials, completing practice questions, or playing quiz games with other students.

3) Homepage and Subjects Page

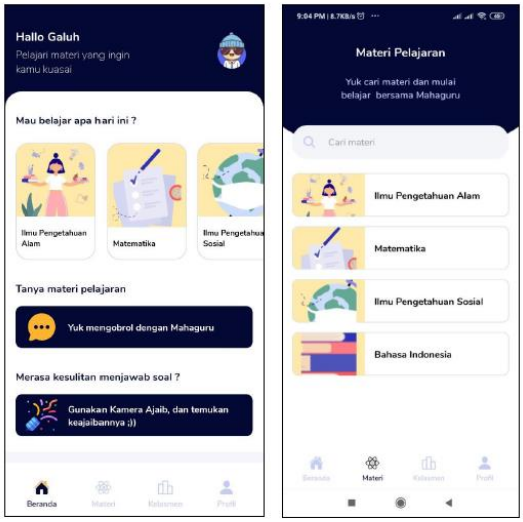

Figure 3 Homepage and Subjects Page

The home page is a page that shows the features of "Mahaguru" elearning such as course materials, chatbot.

The subjects page is a page that displays a list of subjects that can be studied on the "Mahaguru" elearning. This list of subjects has been adjusted to the student's class. The subjects currently available are math, science, social studies, and Bahasa Indonesia.

4) Chapter Lesson Materials and Course Materials Page

Figure 4 Chapter Lesson Materials and Course Materials Page

The Chapter Lesson Materials page is a page that shows the details or parts of the subject chapter that will be studied by students.

The Course Materials Page is a page that shows the material that students will learn. Here

there are pictures and explanations about the related material being studied. At the end of the material, students will get an exercise question.

5) Practice Questions and Results Page

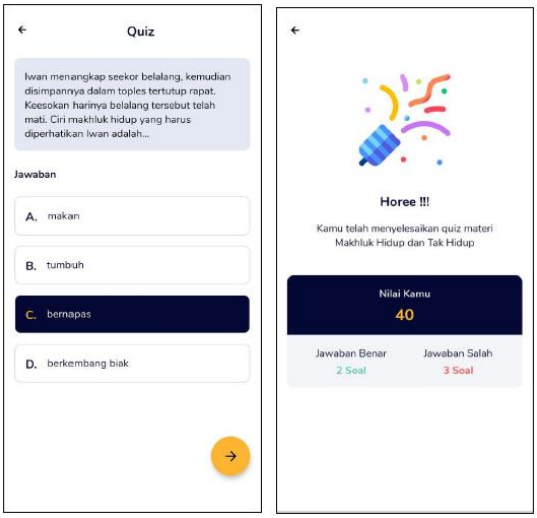

Figure 5 Practice Questions and Results Page

The practice question page is a page that presents practice questions from the material that has been studied. After doing a quiz, students will get a score and points. Students can also see the number of questions, the number of correct answers, and the number of correct answers.

6) Chatbot and Teach Chatbot Page

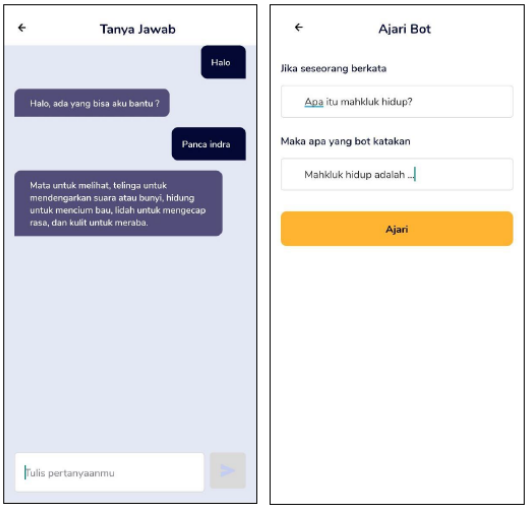

Figure 6 Chatbot and Teach Chatbot Page

The "Mahaguru" chatbot page is a page where students can consult or ask about difficulties in understanding the material. Here later students can also teach the chatbot so that students can learn by asking and also teaching.

7) Quiz Game " Quiz Siapa Jago?" Page

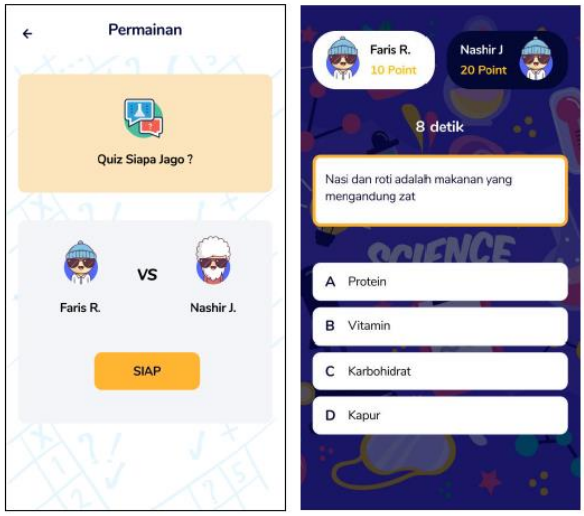

Figure 7 Quiz Game " Quiz Siapa Jago?" Page

The quiz game page is a page where students can practice questions with their friends directly and interactively.

B. Discussion

Mahaguru is a mobile-based application that is useful for elementary school students to conduct the teaching and learning process independently (remotely). Mahaguru has two excellent features, namely Chatbot and Quiz Game. Chatbot in Mahaguru application is a learning assistant for students. Elementary students can learn from the chatbot at any time by asking questions to the chatbot. Students can also teach the chatbot, if the chatbot does not know what the student means so here students can add to the knowledge base of the chatbot and contribute to the world of education in Indonesia. In the quiz game here, students can play games with their friends by playing quiz about the selected lesson. This game can increase the child's competitive spirit in the process of distance learning which rarely has direct interaction between students. Mahaguru also has other features to support the distance learning process, namely materials, practice questions, and others.

The "Mahaguru" application will greatly help the learning process of elementary school students in Indonesia, especially during the current distance learning policy. The author designs the "Mahaguru" application with various interesting innovations so that it can help the world of elementary education in Indonesia. The following is the value of innovation and impact in the utilization of the "Mahaguru" application.

Table 6 Innovation Value and Impact of Software Utilization

#	Innovation Value	Impact
1.	E-learning "Mahaguru" is built using the concept of gamification, which is to include elements of game elements into an application that is not a game. The concept of gamification in the "Mahaguru" application includes: followers, leaderboard, achievement	Fostering students' competitive spirit, because indirectly students will feel competing with their friends even though they don't meet them directly. They can see their friends' learning results through the follower and achievement features, then can see the ranking on the leaderboard feature.
2.	"Mahaguru" chatbot is one such innovation. Here students can experience the utilization of chatbots in the world of education. Chatbot is useful for answering all questions from students related to the material so that students can get tutoring for 24 hours. Here students can also teach chatbot or add to the chatbot knowledge base, by adding words that chatbot does not understand.	Assist students in the remote teaching and learning process. Chatbot can provide interactive answers to students for 24 hours. It can replace the reduced role of teachers during the distance learning period. Here students can also contribute to the world of elementary school education in Indonesia by helping to add to the chatbot's knowledge base, thus increasing the level of intelligence of the chatbot it self.
3.	"Quiz siapa jago" is a feature where students can do live practice questions. They will compete in answering the quiz. Students who win will get points, to increase their ranking on the leaderboard.	Provide students with different, more innovative, interactive and challenging practice problems. Gives students a different experience in doing practice problems and adds to their competitive spirit.

4. Conclusion

In this research, it has been described how the utilization of Chatbot and Gamification in the implementation of mobile-based E-Learning "Mahaguru", so the author can conclude that the existence of this E-Learning application allows students to learn interactively and competitively with the utilization of gamification, students also get personal guidance in helping the learning process independently by using chatbot and the learning process at elementary schools can run more effectively and efficiently.

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