Mathematics Distance Learning with the Utilization of WhatsApp and YouTube Application for Vocational High School Students

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Abstract. Learning loss is one of the challenges during the Corona Virus Disease (COVID-19) pandemic in teaching and learning. The teacher must carry out distance learning according to the conditions of the students. This study used WhatsApp and YouTube to produce a mathematics distance learning design. The developed model was adapted from Plomp development model by carrying out three phases: preliminary, design, and realization or construction [1]. In the preliminary phase, the activities were carried out a literature study, collecting data through a questionnaire to 68 students in the 12^{th} grade in a vocational high school in Bandung, analysing internet quota consumption, and interviewing. In the design phase, design prototypes and learning instruments were produced. In the realization/construction phase, a description of the implementation of the design prototype with the limit of function topic was created. The results of this study were (1) WhatsApp is the most needed application accompanied by explanations through learning videos on YouTube, (2) prototypes of designs and learning instruments, and (3) a description of the application of design prototypes and learning instruments.

Keywords: Distance Learning · Learning Loss · Plomp Model · WhatsApp · YouTube

1 Introduction

During the implementation of distance learning, concerns arise about learning specifically, or academic decline occurs due to certain conditions such as a long gap or non-continuation of the educational process [2]. Most students have experienced learning loss during the spread of Corona Virus Disease (COVID-19) [3]. Learning loss is caused by various obstacles, including inadequate facilities and infrastructure for distance learning. Students whose home facilities are inadequate can potentially experience learning loss [4]. Furthermore, the teacher realizes the challenge of learning loss, which plays a direct role in the learning process. Based on the report, 67% of teachers experienced difficulties in using digital technology [5], and 35% of students experienced difficulties in internet access [6].

F. Nurhasanah and R. S. Padmi (Eds.): ISMEI 2022, AHSSEH 9, pp. 114–125, 2023.
https://doi.org/10.2991/978-94-6463-220-0_13

During the pandemic, learning is organized in the virtual mode, especially at the beginning of the new academic year 2021/2022. This is a policy based on the instructions in the Instruction of the Minister of Home Affairs Number 22 of 2021 concerning the public activity restriction level four of COVID-19 in Java and Bali regions [7]. Therefore, distance learning is needed and adjusted according to the conditions of students. It is considered that in the new academic year 2021/2022, the implementation of distance learning is entering its second year after having limited time with face-to-face learning. Various evaluations, innovations, and the development of learning models are needed.

Various alternative applications can be used for distance learning, including WhatsApp and YouTube. WhatsApp is a social media platform that can be used to send messages, images, documents, user location, audio/video and other media files. Nevertheless, it can be applied and developed as a learning innovation strategy [8]. A WhatsApp Group is a place that provides students connect with other students to ask and discuss on mathematical concept or mathematics problems and to monitor students' interactions [9]. Meanwhile, YouTube is a popular social media platform for accessing and sharing videos with various internet quota-saving features and as a substitute for face-to-face learning [10]. In teaching and learning, YouTube can be used as a video repository to help teachers and students [11]. From the explanation above, the researcher aims to develop online mathematics learning using WhatsApp and YouTube.

2 Method

A methodology used in this study is development research with the Plomp development model, which aims at producing distance learning mathematics designs using WhatsApp and YouTube as the learning platform [1]. The Plomp model is more flexible than other development models because each phase of its activities can be adapted to the characteristics of the study [12]. The Plomp model consists of (1) the preliminary investigation phase; (2) the design phase; (3) the realization/construction phase; (4) the test, evaluation, and revision phase; and (5) the implementation phase [1]. Due to limited learning time during the pandemic, this study uses three phases: (1) preliminary investigation phase, (2) design phase, and (3) realization/construction phase. In the preliminary phase, the activities were reviewing literature, a questionnaire was distributed via Google Form to 68 twelfth-grade students at a vocational high school in Bandung for data collecting, analyzing internet quota consumption, and interviewing. In the design phase, designing prototypes and learning instruments were produced. In the realization/construction phase, a description of the implementation of the design prototype with the limit of function topic was created.

3 Results and Discussion

In the following section, a description of the process of using the three phases of the Plomp model will be presented in a vocational high school located in Bandung, Indonesia. Data for each phase will be presented using tables and figures.

3.1 The Preliminary Investigation Phase

In the preliminary investigation phase, the essential elements include information gathering and analysis, problem definition, and planning for the possible continuation of the project [13]. According to a questionnaire distributed to students, 22.06% reported that online learning was effective, 39.71% indicated that online learning was ineffective, and 38.23% reported that online learning might be effective. These percentages were based on the students' previous online learning experiences, which had previously only consisted of task collection activities without adequate explanation. Table 1 illustrates the students' previous learning experiences, with each student labeled as S1 to S6.

Based on Table 1, S1 shared their previous online learning experiences, which involved being assigned tasks without any accompanying explanations of the material. This experience was also reported by S4, S5, and S6. S4 encountered difficulties using learning support applications, and found it challenging to understand the subject when only provided with text-based teaching materials and pre-recorded videos that were not created directly by the teacher. In addition, 13.24% of students encountered problems with limited internet quota, as reported by S1, S2, S3, S5, and S6. Therefore, it is essential to choose an online learning application that meets the needs of students. Figure 1 displays the choices of online learning applications made by students.

Table 1. Student's Previous Online Learning Experiences

Student	Experience
S1	In my opinion, the previous online learning experience was not good because I had a lot of complaints. Some teachers only gave assignments without explaining the material in advance, and there were obstacles such as full phone memory and insufficient internet quota that prevented me from participating in online learning. These issues caused me to postpone doing assignments.
S2	The tasks are manageable, although I sometimes have difficulty understanding the lessons. The main issue is a lack of understanding, but internet quotas are often a constraint, and my cell phone is frequently slow. 😂🙏
S3	There are numerous issues when using Google Meet, particularly with regards to internet quotas. Unfortunately, we are often limited by the chat package rather than having a dedicated internet plan. Additionally, the explanations provided can be unclear at times. *Hehe.* However, if the instructions are presented in a simple and clear manner, they can be easily understood
S4	The explanations are not well understood, and when questions are asked, there is often a slow response, which can delay progress on assignments.
S5	Not everyone is able to participate in online learning due to various reasons such as limited internet quota or difficulties accessing the application. Furthermore, some students may struggle to understand the lessons, and this can be a source of frustration. 😂
S6	There are many distractions that can impede learning, including issues with internet connectivity, limited internet quota, and difficulty in understanding complex materials.

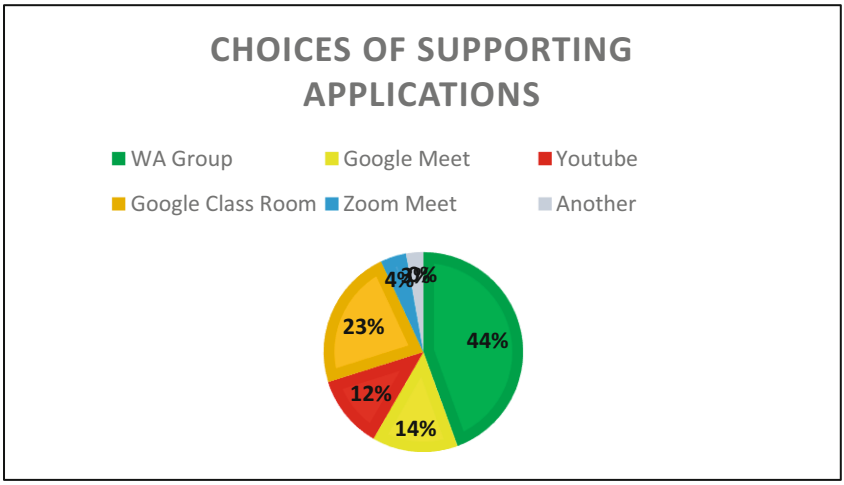

Fig. 1. Choices of supporting applications

As shown in Fig. 1, WhatsApp is the most popular online learning application with a usage rate of 44%, while YouTube ranks fourth. The students' preference for the WhatsApp platform is attributed to its wide accessibility and low bandwidth consumption [14]. The finding contradicts the results of the questionnaire and interviews, in which YouTube is needed to support the explanation. Also supported by auto, Higher, and data saver features on YouTube which can be used to save internet quota consumption [15]. To ensure that the access to videos is seamless, YouTube has the option to employ centralized and decentralized methods for balancing requests on its cache servers [16]. Especially now that YouTube is a source of knowledge that even young children can access [17]. Therefore, based on the explanation above, WhatsApp and YouTube were chosen as applications used for learning.

3.2 The Design Phase

In the design phase, we developed design prototypes and learning instruments. The design prototypes consisted of three categories: roles in learning, supporting applications, and interaction design. In addition, we produced learning instruments such as lesson plans, assessment sheets, and learning videos.

Roles in Learning. In the learning process, the teacher's roles include providing materials, facilitating discussions, clarifying student opinions, and conducting evaluations. Meanwhile, students take on the role of learning subjects and actively participate in class discussions and evaluations.

Supporting Applications. WhatsApp and YouTube were utilized for the implementation of the study. Teachers sent multiple learning contents in the form of videos or files through the WhatsApp application and interacted directly with students via video calls or chat [18]. The WhatsApp group feature was also used to send messages, allowing users to interact in one place simultaneously. The study's results supported WhatsApp as

an application for a discussion group [14, 19]. Currently, WhatsApp groups are widely used as forums for discussions to solve various problems, questions, and convey important information to its members [20–22]. Students are more likely to use YouTube for educational purposes if digital learning resources can improve their academic abilities [23]. If students do not understand the content, they can replay some or all of the learning videos on the list [24]. Additionally, YouTube has a video resolution control feature, enabling students to reduce internet quota consumption [10].

Instruments. The 5–15 min learning video on 'Limit of functions' was presented. The duration is included in the ideal duration. The ideal duration of learning videos on YouTube is 5–30 min, with an ideal percentage of 44.8% [25]. The learning method used is discussion. The discussion method confronts students with problems to solve, questions to answer, knowledge to add and understand, and decisions to make [26]. Specifically, the objectives of the study, the students should be able to: (1) find out the properties of limits of algebraic functions, (2) determine the limit values of algebraic functions, and (3) solve problems related to the limits of algebraic functions. Learning is done by interacting through a WhatsApp Group and watching specific YouTube videos. The type of assessment used in this research is an assessment of knowledge, skills, and attitudes. Knowledge assessment is based on the accuracy and suitability of students' answers during discussions, assignments, and quizzes. Skills assessment is based on the completeness of the material notes and assignments that students have completed. Meanwhile, attitude assessment is based on attendance, participatory attitude, and active asking/answering in online discussion opportunities.

Interaction Design. The interaction of teachers and students is supported by using WhatsApp and YouTube applications. The interaction runs synchronously in both directions, which is displayed in Fig. 2.

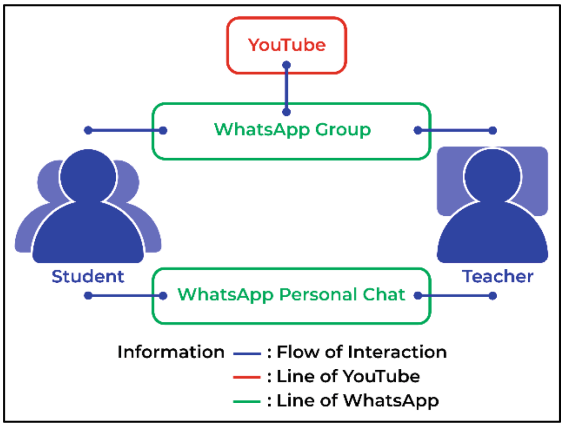

Fig. 2. The framework of the interaction design.

3.3 The Realization Phase

The realization phase focuses on implementing the design prototype and the instruments from the design phase. Learning is carried out in six sessions. In each session, there is one video discussion, as illustrated in Fig. 3.

The Opening Activities. In the opening activities, the teacher greets and motivates students, checks students' attendance, gives an apperception, and asks students to access videos via links (YouTube). Interaction is done by writing messages and using the voice note (VN) feature. Through VN, students also state attendance by stating their full name, the date of the learning session, and saying '*hadir*' or 'present'. Below are pictures of the opening activities presented in Figs. 4 and 5.

Core Activities. In the core activities, the teacher led a WhatsApp group discussion after the students had listened to the learning video. The students wrote comments in the YouTube comments section to show that they had listened. Next, the students were invited to ask questions, provide answers, and respond to the topic being studied. 75% of the students participated in the learning, and 18.75% participated actively. Figures 6 and 7 show the core activities.

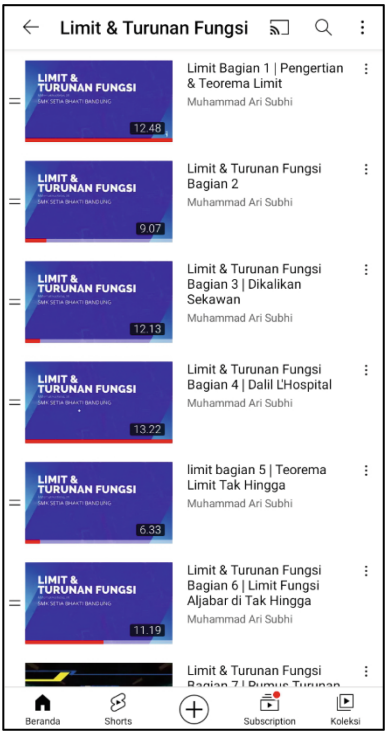

Fig. 3. Learning videos playlist.

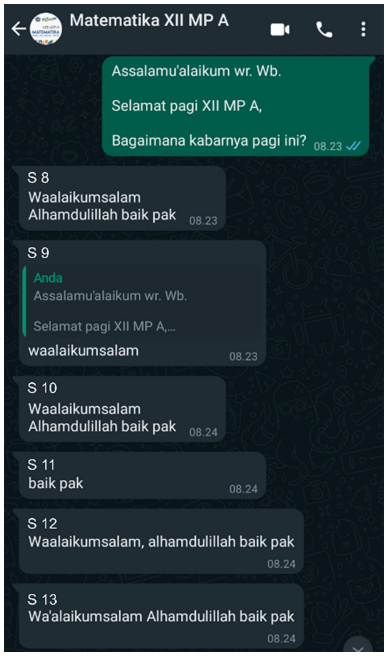

Fig. 4. The teacher greets and motivates students.

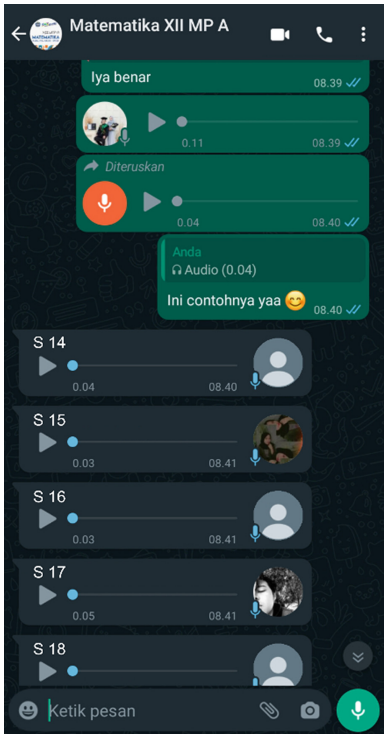

Fig. 5. The teacher checks students' attendance.

Fig. 6. Discussion through WhatsApp group.

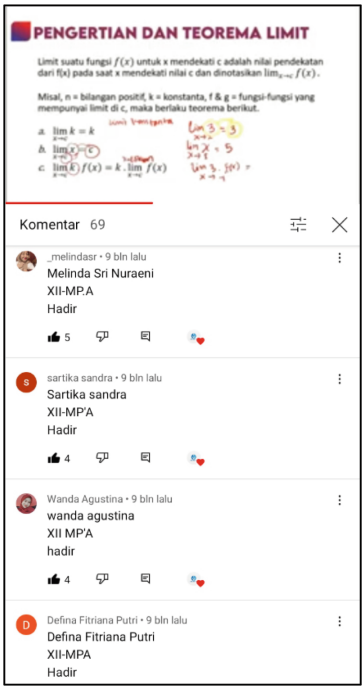

Fig. 7. Students watched videos on YouTube to learn.

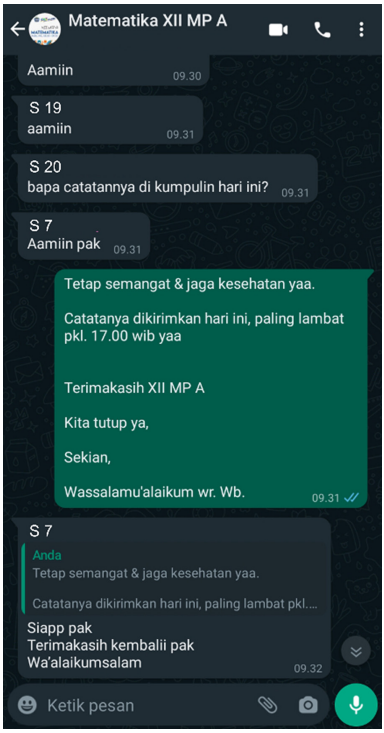

Fig. 8. Closing activities captured in WhatsApp group.

The Closing Activities. In the closing activities, the students were asked to conclude the lesson. Additionally, the teacher provided clarification and then closed the session with a greeting, as shown in Fig. 8.

The Evaluation Activities. In the evaluation activities, students sent their material notes and assignments to the teacher via private messages or personal chat for follow-up, and the teacher provided feedback. The given feedback was intended to help students understand whether the steps they took to solve the given problem were appropriate. If a step was found to be inappropriate, the student revised and resubmitted the results. A picture of the evaluation activities is presented in Figs. 9 and 10.

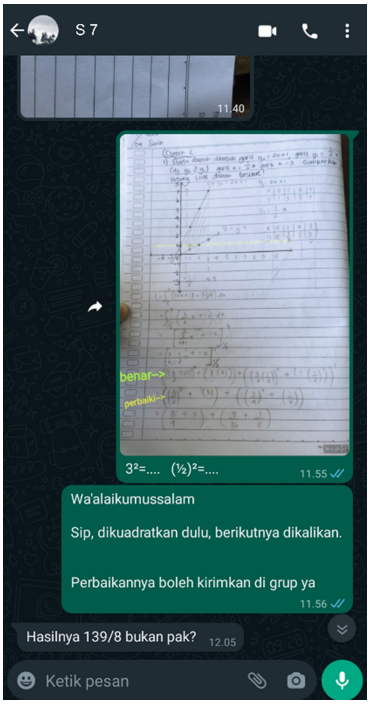

Fig. 9. Evaluation activities captures in personal chat (a).

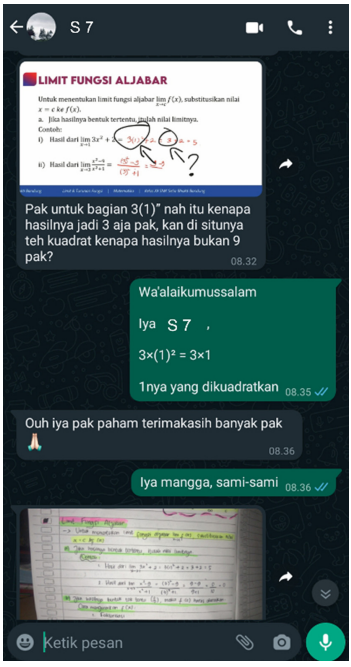

Fig. 10. Evaluation activities captures in personal chat (b).

4 Conclusion

Based on this study, the preliminary phase shows that the thing that students needed the most was video explanations which can be accessed via YouTube. In the design phase, we developed prototypes of designs and learning instruments. The realization phase describes the implementation of design prototypes and learning instruments. Mathematics distance learning with the use of WhatsApp and YouTube applications for vocational high school students has the potential to provide effective and efficient learning. This finding was supported by students' active participation in the learning process and how the applications are easy to operate for interaction.

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