Preliminary study of physics e-module development using research-based learning model through smartphone to support digital learning in the revolutionary 4.0

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Abstract. The era of revolution 4.0 emphasizes the application of technology in life, including education. Example of the application of technology in education is digital learning which helps students teach technology to help them in the future. In physics learning, the use of technology is still not optimal. This is indicated by Physics learning materials used in schools that are still in print and learning activities are still centred on the teacher face-to-face. The spread of the Corona virus causes learning activities cannot be done face-to-face because not all schools are permitted to carry out learning activities. Therefore we need electronic learning materials that are able to improve the competence of attitudes, knowledge and skills of students even though not face-to-face. E-module with Research-based Learning model through smartphone is very appropriate learning material used to improve these three competencies and support digital learning. This study analyzes e-module development using Research-based Learning model in 10th grade physics subject on the first semester that discusses the analysis of needs, characteristics of students, materials and task analysis. Research method used is quantitative descriptive research with research sample are students of SMAN 10 Padang, SMAN 12 Padang and SMA Pertiwi 1 Padang.

1. Introduction
Currently the world has entered the era of the industrial revolution 4.0 or better known as the digital revolution. The era of the industrial revolution 4.0 emphasizes the application of artificial intelligence or technology in life, such as the use of robots as a cheaper, more effective and efficient substitute for human labor [1]. This of course creates advantages and disadvantages for humans. One of the downsides of this change is the increase in unemployment due to human jobs being replaced by smart robots [2]. Therefore, efforts are needed to face these challenges by improving the quality of human resources who can compete in the future through improving the quality of education.

Efforts to face the challenges in the 4.0 revolution era is to improve the education system that is able to produce creative, innovative and competitive graduates. One of the ways to achieve this is by optimizing the application of technology as a tool in the implementation of the learning process which will form a generation that understands technology and is able to keep up with the times [3]. The learning process that utilizes technology in its implementation is called digital learning. Digital learning is web-based or digital learning, which allows students and teachers to communicate interactively by utilizing technology such as cellphones, computers or laptops connected to the internet.
and various other applications [4]. This allows the learning process not only to be carried out in class face-to-face, but can also be done anywhere and anytime.

Digital learning is very much needed in the midst of the Corona virus pandemic that is happening today. All human activities are hampered and tend not to be carried out, ranging from economic, social and even learning activities at school to be disrupted. The pandemic that hit all countries including Indonesia, caused most schools to be closed and diverted to be carried out online from the homes of individual students. Based on the decision of the Minister of Education and Culture of the Republic of Indonesia No. 36962, learning is carried out online from home in order to prevent the spread of the Corona Virus. This is a challenge for both teachers, students and the government so that learning continues well even though it is not face to face in class. Through the application of digital learning, teacher and student interaction can be carried out online through real audio, real video and other online discussion support applications as well as expanding the reach of learning that is not limited to space and time [4].

The implementation of digital learning in the era of the 4.0 revolution requires supporting facilities and infrastructure such as cellphones, computers/ laptops and adequate internet connection. In addition, things that must be prepared in digital learning are good learning materials that attract students and are easy to use [5]. Learning materials are everything in the form of materials or subject matter that are systematically arranged based on learning principles to achieve certain competencies [6]. One type of learning material is a module. Modules are learning materials that allow students to learn independently by following scientific steps [7].

The reality found in schools is that the learning materials in the form of modules used in learning physics are still in printed form that have not been updated for a long time, so that the module has limitations that only contain text and pictures. But in reality, the modules needed are modules that are attractive and integrate study manuals, multimedia and even online sites that students can access [5]. In addition, the learning model used by the teacher is still a conventional model where the teacher is the center of learning, even though currently the activeness of students is more demanded. This shows that learning physics requires the development of learning materials and the application of learning models that support the implementation of digital learning.

The solution to this problem is the development of a physics module in electronic form that applies a learning model that guides students to actively learn independently. What's new about this research is that the e-module is used via a smartphone which makes it easier for students to study independently anywhere and anytime and is easy to carry anywhere. E-modules are arranged in accordance with the general arrangement of modules but are added with the syntax of research-based learning models. Research-Based Learning Model is a learning model that instills a scientific spirit in students because it integrates research or research conducted by students in learning activities [8]. The electronic module (e-module) with the smartphone-assisted Research Based Learning model is a very appropriate learning material to use to improve the three competencies (attitudes, knowledge and skills) of students and support digital learning in the era of revolution 4.0. In developing this e-module, a preliminary study is needed which aims to describe the situation of students, teachers and the implementation of learning that has been done in school. Therefore, a preliminary study of the development of high school physics e-module for class X semester 1 using the smartphone-assisted Research Based Learning model to support digital learning in the era of revolution 4.0 is needed.

2. Research Method

This research is included in the type of qualitative descriptive research which was conducted in February and March 2020 in three high schools in Padang city. Qualitative descriptive research is research that describes a condition or variable being studied as it is [9]. The description of the research variables is expressed in numerical form and then interpreted into certain predetermined categories [10]. This research was conducted to describe and analyze the needs and characteristics of students in learning physics in the 4.0 revolution era. Class X students totaling 82 people from SMA 10 Padang, SMA 12 Padang and SMA Pertiwi 1 Padang were the samples in this study. The research instrument
used was a student questionnaire sheet consisting of 60 statements with five answer choices, namely strongly agree (4), agree (3), disagree (2) and strongly disagree (1). The data obtained in this study is quantitative data processed in percentage form and interpreted in the form of scientific narrative proposed by Riduan [11] as shown in Table 1 below.

| No. | Percentage | Category   |
|-----|------------|------------|
| 1   | 0 -20%     | Very low   |
| 2   | 21% - 40%  | Low        |
| 3   | 41% - 60%  | Moderate   |
| 4   | 61% - 80%  | High       |
| 5   | 81% - 100% | Very high  |

3. Result and Discussion
The development of e-modules using the Research Based Learning model is a solution to the problems found in the preliminary study. The results of data analysis in this study were obtained through the needs questionnaire sheet and the student characteristic questionnaire which was filled in by 82 respondents. Sub indicators in the analysis of student needs include performance analysis, graduation standards and learning difficulties analysis. Sub indicators of the analysis of the characteristics of students include interest and motivation to learn, learning styles and competence of students.

3.1. Result of Need Analysis
The needs analysis stage is indispensable in developing a product, including the development of a physics e-module. Quality education can be identified by meeting the needs that support the learning process. Needs analysis is described through performance analysis, passing standards and analysis of learning difficulties of students.

3.2. Result of Performance Analysis
The results of the performance analysis aim to describe the performance that must be mastered by students after participating in learning activities. Performance analysis in terms of teacher identification and the completeness of supporting facilities and infrastructure for the implementation of learning in schools. Identification of good teachers and adequate facilities and infrastructure available in schools can help students to form good performance as well. Based on the processing of questionnaire data at SMA 10 Padang, SMA 12 Padang and SMA Pertiwi 1 Padang, the performance analysis is described in Figure 1 below.
The teacher's ability to create a pleasant learning atmosphere depends on the learning model applied, the learning materials used and the teacher's role in learning. The ability of teachers in the three schools to create a good and interesting learning process is still not optimal as shown in Figure 1. This can be seen from the average percentage value of teacher identification in SMA 10 Padang is 59%, SMA 12 Padang is 57% and SMA Pertiwi 1 Padang is 54% where the ability of teachers in the three schools is in the medium category. If sorted from these percentages, it can be seen that the highest identification of teachers is owned by physics teachers at SMA 10 Padang. So that at this time it is very necessary to improve the quality and ability of teachers in creating a teaching process that is interesting and runs well, namely by making learning devices that are in accordance with the content standards and basic competencies of the 2013 curriculum.

The results of the questionnaire analysis of the facilities and infrastructure in the three sample schools showed that the facilities and infrastructure provided by the school were quite good. However, the completeness of the facilities and infrastructure is still not optimal in terms of the use of physics laboratory equipment for practicum activities. Physics practicum activities are not carried out by the teacher for every Basic Competency (KD) that is learned. In addition, most of the learning materials used in schools are only printed learning materials and the limited use of school wifi for students. This is shown in Figure 1 that the percentage of completeness of facilities and infrastructure in SMA 10 Padang, SMA 12 Padang and SMA Pertiwi 1 Padang in order of 59%, 52% and 47% (moderate category).

3.3. Result of Graduation Standards Analysis
Graduate Competency Standards analysis serves as an assessment guide in determining student graduation. According to the Government Regulation of the Republic of Indonesia No. 19 of 2005, graduate competency standards are competencies that graduates must possess which include attitudes, knowledge and skills [12]. According to the results of the assessment by the class X physics teacher at SMA 10 Padang, SMA 12 Padang and SMA Pertiwi 1 Padang, the average scores of the competence attitudes, knowledge and skills of students from the three schools are described in Figure 2 below.

The analysis of the competency standards of graduates in the three sample schools shows that the scores vary. Based on the graph shown in Figure 2, the three competencies possessed by students are already in the high category, but the competence of students' attitudes has a better percentage than the competence of knowledge and skills. The lowest percentage of competencies is the skill competence of students at SMA 10 Padang, SMA 12 Padang and SMA Pertiwi 1 Padang with the percentages respectively, namely 71%, 65% and 64% which are included in the high category. In the physics learning process, the skills of students can be trained through in-class discussion activities and practicum activities in the laboratory. Therefore, efforts are needed to improve the knowledge competence and students' skills by improving the learning process.
The competence of students' skills is not optimal due to practicum activities that are not optimal. Based on the data obtained from student questionnaires, physics practicum cannot be done for every Basic Competency studied. This is due to limited time and incomplete physics practicum tools. So that a more effective practicum method is needed in terms of time and practicum tools used, one of which is by doing a virtual practicum.

3.4. Result of Learning Difficulty Analysis.
The purpose of the analysis of learning difficulties is to determine the factors that cause students' difficulties in learning and to find ways to minimize these difficulties. How to minimize learning difficulties is to use learning models, technology in learning and learning materials suggested by the 2013 curriculum. One of the learning materials that can be used in learning physics is a module. The learning model that can be used in learning is the Research Based Learning model, because physics is a science from the results of scientific research. Meanwhile, the media that is most suitable for use in learning today is digital learning media that utilizes technology in the learning process.

The results of the analysis of learning difficulties faced by class X students in SMA 10 Padang, SMA 12 Padang and SMA Pertiwi 1 Padang on the aspects of the applied learning model, technology in learning and the learning materials (modules) used are described in Figure 3.

Based on the graph in Figure 3, learning difficulties are caused by the application of learning models and physics modules and the application of technology in learning that is not optimal. In the three sample schools, the application of the learning model according to the 2013 curriculum is still not optimal, namely in the low to moderate category. However, of the three schools, the learning model used in SMA 10 Padang was better than the other two schools with a percentage of 63% (moderate category).

In the aspect of the physics module used in the three schools, it is still not optimal, namely in the low to moderate category (less than 80%) as shown in Figure 3. In addition, the application of technology in physics learning is still not optimal with a percentage between 50% and 71%. Among the three sample schools, the use of technology was higher, namely in SMA 10 Padang where teachers had combined printed learning materials with electronic learning materials. Thus the three aspects must be applied optimally so that learning difficulties can be overcome and student learning outcomes increase.

3.5. Result of Need Analysis
The function of analyzing the characteristics of students is as a guide and material for consideration for teachers in designing learning, because the characteristics of each student are different. Aspects of the characteristics of students analyzed include the interests and motivation of students to learn physics, learning styles and competencies of students [13]. Competencies possessed by students
include competence attitudes, knowledge and skills. The results of the analysis of the characteristics of students in the three sample schools are shown in Figure 4 below.

![Figure 4. Analysis of Student Characteristics](image)

Based on the data shown in Figure 4, the students' interest in learning and motivation in learning physics is still not optimal, namely 54% and 70% in the low to moderate category. Students' interest and motivation have not been optimal because physics is considered a difficult subject to understand and students' low curiosity to learn and solve physics problems. Meanwhile, the learning styles of students are quite varied but have similarities, namely they prefer to learn physics through video or learning media that can be seen directly compared to just listening and recording what the teacher says with a percentage of between 54% to 70%. Competence of students' attitudes on student learning is better than competency in knowledge and skills. The knowledge competence of students is not optimal because of the difficulty of students to understand the concepts of physics and the less optimal implementation of physics practicum. Whereas by carrying out practicum activities, competency knowledge and skills can be trained properly.

The era of revolution 4.0 encourages the application of digital technology in various aspects of human life. The use of technology in the economic sector causes unemployment because human tasks have been replaced by smart robots. If this continues, it will disrupt human activities. Therefore, the quality of human resources must be improved through quality education as well. An education system will be of quality if all aspects of education support one another. These aspects of education are teachers, students, the learning process that includes materials and methods, tools / media, facilities and infrastructure as well as learning evaluation [14]. The teacher is the main character of learning who must be able to create good learning tools, one of which is learning materials that are arranged according to the 2013 curriculum rules. One of the learning materials that is often used in physics learning is modules. The modules used in schools are generally still in printed form so that they do not support the digital learning process which requires the use of technology in learning. This indicates that the physics learning process in schools has not supported digital learning in the era of revolution 4.0 because it does not use digital technology, digital media such as computers and does not use learning materials that help students' independence [15].

Physics is a science that is closely related to the collection of knowledge, ways of thinking and investigation [16]. The form of the investigation is in the form of practicum activities carried out in school laboratories. The 2013 curriculum requires the implementation of practicum activities for each
subject matter taught. Physics practicum activities can be carried out if the supporting facilities and infrastructure for the implementation of the practicum are completely available at school.

The facilities and infrastructure available at schools are still inadequate, especially in the provision of facilities and infrastructure for practicum activities. Physics practicum activities in schools cannot be implemented for every Basic Competency required in the 2013 Curriculum. This is due to the incomplete physics practicum tools in schools, both in terms of the number and quality of tools that are not suitable for use. In addition to limited tools, the cause of not maximal implementation of practicum activities is limited time or lesson hours, namely 3 lesson hours for class X. So that practicum activities are needed whose implementation is not limited to space and time, namely virtual practicum [17].

Learning models are patterns or learning steps to achieve learning objectives [18]. Learning model is anything that is systematic as a teacher's guide in carrying out learning activities that have sequential steps or learning syntax [19]. Through the application of a learning model used by the teacher must be able to create a pleasant learning atmosphere and increase the activeness of students in learning [20]. One of the learning models that are suitable for increasing the activeness of students in learning physics is the Research Based Learning model, which is a learning model that emphasizes the activeness of students to act as researchers in finding concepts in learning independently [21]. But in reality, the learning model used in schools does not support the increase in the activeness of students because the learning model used is teacher-centered and students are only passive listeners.

Students are a very important component of learning. Determination of learning methods and models must be adapted to the characteristics of students, because each student has different characteristics. The characteristics of students analyzed include aspects of interest and learning motivation, learning styles, as well as competence attitudes, knowledge and skills of students. All these aspects are related to one another. If the motivation and interest of good students will help increase the competence of students. So that the learning program to be carried out by the teacher must be adjusted to the characteristic aspects of these students.

Based on the results of the analysis of the characteristics of students, data was obtained in the form of a percentage in the low or poor category. This is indicated by the low interest and motivation of students to learn and the competence of attitudes, knowledge and skills of students who are still lacking. Therefore, this preliminary study research can be used as the basis for e-module development using the smartphone-assisted Research Based Learning model to support digital learning in the era of revolution 4.0 in physics learning for Class X Senior High School.

4. Conclusion
The results of the preliminary analysis that have been carried out indicate that the physics learning activities of class X SMA students have not supported digital learning, because the application of digital technology both in the implementation of learning and in making physics learning materials or media is still not optimal. This is evidenced by the low results of the needs analysis and analysis of student characteristics that demand action to maximize the use of technology in learning physics. So it is necessary to develop electronic learning materials, namely e-modules with a smartphone-assisted Research Based Learning model to support digital learning in the era of revolution 4.0 in high school physics learning in Class X.

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