



# Analysis of STEM-Based Student Worksheet Development with *Scaffolding* using the Web

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**Abstract:** This study aims to analyze the needs of teachers and students on the development of learning media in the form of STEM-based student worksheets with scaffolding using the web. The development is carried out using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. Data obtained through interviews submitted to teachers. Teachers need an interesting learning media and can help students understand the material. While students need learning media that can help students towards understanding concepts. So that researchers will develop student worksheets using the web. Products produced in web form and based on STEM with Scaffolding.

**Keywords:** Student worksheets; STEM; Scaffolding; Web.

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## Introduction

The Covid-19 pandemic has caused major changes in almost all aspects of life, one of which is education. Changes in the education system make it difficult for students to receive material, because learning that is usually done conventionally turns into learning by utilizing information technology or learning using electronics (Salsabila et al., 2020).

In the field of education, the government through the Ministry of Education and Culture (Kemendikbud) strives so that educators such as educators and students can still organize teaching and learning even though in different ways (Cahyani et al., 2020). The Ministry of Education and Culture encourages the implementation of the teaching and learning process to be carried out using Blended Learning. Conditions like this require educators to replace learning using offline (face to face) and online (online media) (Pamungkas & Dwiyoogo, 2020).

In the implementation of blended learning, it presents its own challenges for educators, because in its

implementation educators must find ways how to continue to deliver learning materials and can be easily accepted by students (Mulyadi et al., 2016). Many educators in the online learning process (online media) are carried out using various applications such as WhatsApp, Google Meet, Google Classroom, and E-learning.

The online learning process requires students to study independently. According to (Sihotang, 2020) in the online learning process students are required to study independently at home with the help of parents. The implementation of online learning is determined by several supporting factors including mobile phones, quotas, and internet networks as well as the availability of appropriate teaching materials (Putria et al., 2020). One of the teaching materials needed during online learning is teaching materials with the help of the web which are carried out online by students wherever and whenever via internet media (Saluky, 2016).

According to (Ermaniatu, N., 2017) one of the teaching materials is a worksheet. Teaching materials are components that cannot be separated from a

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learning process. Teaching materials are made so that students are able to get information that is in accordance with the competency bill that has been prepared in such a way in the curriculum that applies in a school (Komalasari et al., 2019). One way for students to understand the material independently is by using a web-based worksheet (Sasmita et al., 2021). Student Worksheet is used as teaching materials to direct students in learning. Student Worksheets are also used as a guide so that students can carry out active and independent learning activities. Student worksheet is one of the media that students can use as a guide in conducting investigations or problem solving activities (Wahyuni et al., 2021).

The saturation of students in using Student worksheet so far is because learning activities using Student worksheet are only used to answer multiple choice questions and are still in the form of printed worksheets so that students get bored easily. While the online learning process requires educators to use teaching materials with technology or electronics. Student worksheet in physics learning is expected to be able to develop knowledge and skills so that they can be applied in everyday life and are designed in an attractive manner in order to improve students' understanding of concepts.

One of the current 21st century learning approaches to support 6C skills (communication, collaboration, compassion, critical thinking, creative thinking, computation logic) (Nadeak et al., 2020) is the STEM approach. STEM approach to learning is expected to produce meaningful learning for students through the systematic integration of knowledge, concepts, and skills (Syukri et al., 2021). STEM is a learning process that allows individuals to explore environmental problems, engage in problem solving, and take action (Amalya et al., 2021) Torlakson in (Matondang, 2019) revealed that STEM is an approach that encourages hands-on experience and gives students the opportunity to acquire and apply relevant real-world knowledge in the classroom. In STEM-based learning, students use science, technology, engineering, and mathematics in real contexts that allow students to compete in the 21st century (Yusuf and Asrifan, 2020). Later with this STEM approach, it will be included in the web-based Student worksheet by completing the STEM components, namely Science, Technology, Engineering and Mathematics in one worksheet.

One of the obstacles in the online learning process is that students are not able to solve the problem independently, meaning that parental assistance or guidance is still needed. Based on research conducted by (Utomo et al., 2021) which says that the problems that occur during the online learning process at home, students still find it difficult to study independently

which can be seen from the learning difficulties experienced by students. (Wardani & Ayriza, 2020) also describes problems in the online learning process that are also experienced by parents where parents do not understand the material. One solution in solving the problems experienced by students when they have difficulty understanding the material is to provide an assistance called Scaffolding which was pioneered by Vygotsky.

According to (Fajriani et al., 2021) Scaffolding is assistance provided by the teacher in learning activities in the classroom. The assistance can be in the form of questioning, prompting, cueing, and explaining. Learning physics using scaffolding is considered to be able to overcome the low understanding of students' concepts in physics learning (Diani et al., 2019).

Analysis of the initial needs of teachers is carried out so that the products developed can match the needs needed in schools in the learning process. Thus, the product developed can be used and in accordance with the needs in the learning process. The purpose of this study was to analyze and explore the needs of teachers for the development of learning media in the form of STEM-based student worksheets with scaffolding in an attractive, easy-to-use, and useful web form in the learning process.

This important research is to find out the needs of teachers and students for the development of learning media used in schools in the learning process and will later be used in developing products in the form of STEM-based worksheets with scaffolding using the web.

## Method

This research was conducted by analyzing the needs of teachers in one of the SMA N in Jambi City. This study uses the type of research and development (Research and Development). Research and Development (R&D) method is a research method that produces a product in a certain professional field, followed by several by-products, and has the effectiveness of the product (Sambiu & Amir, 2018).

The development design used by the researcher is the ADDIE development model (Analysis, Design, Development or Production, Implementation or Delivery and Evaluations). Researchers chose this model because the ADDIE model is a general learning model and is suitable for development research (Anandari et al., 2019). The first stage of this development research is the analysis stage. In this needs analysis there are several activities, namely: Analyzing existing problems, Setting Goals, Student

Analysis, Analysis of Available Resources, and Material Analysis.

At the stage of analyzing the existing problems, the steps taken by the researcher are to find out the problems faced in schools. It aims to identify and identify problems related to the learning process. This stage is carried out by interviewing physics subject teachers so that student worksheets designed in the future can be used to solve problems encountered during the learning process.

Next is to determine the purpose of the Student Worksheet design. Student Worksheets that are designed later must be adjusted to the learning objectives that students want to achieve in order to follow KI and KD. Furthermore, this analysis aims to identify the resources that will be needed. This analysis is also used to determine whether the selected school as the object of research is willing to assist the research

process and determine human resources that support the process of developing student worksheets using the ADDIE model.

The last one is Material Analysis. At this stage, researchers will examine the curriculum applied in schools and researchers will analyze KI, KD, and indicators that become references in developing products.

### Result and Discussion

Based on the results of interviews conducted with physics subject teachers related to the need for teaching materials and the importance of this product, it can be seen in table 1.

**Table 1.** Analysis of Teacher Response

| Question   | Answer   |
|--|--|
| What curriculum is used in this school?  | 2013 Curriculum  |
| How is the use of media in learning activities?  | Less use of media  |
| What learning books are used in learning? Which book is it from?   | Student worksheet, book, published by the triumvirate  |
| Do you use supporting media during the learning process such as Student Worksheets?                                      | Yes  |
| How is the Student worksheet used? Where is the source of the experiment/material used?                                  | The Student worksheet used uses Student worksheet from schools and experimental sources from the internet. |
| Did you know about STEM? Have you ever used a STEM-based Student worksheet?  | I know, but never using because the material is too short Student worksheet                                |
| How is technology used in learning activities? Like the use of smartphones, computers?                                   | Haven't fully used the computer yet, but already using smartphone  |
| How about developing learning support media such as STEM-based web worksheets with scaffolding?                          | Really agree   |
| Have you ever used Student worksheet in web form?  | Never  |
| Have you ever used the Scaffolding approach in the learning process? Once  | Yes, I use   |
| What kind of assistance is often used in the teaching and learning process? (Questioning, Prompting, Cueing, Explaining) | Refer to questions and examples  |

Based on interviews that have been conducted that the school has implemented the 2013 curriculum. Based on the Regulation of the Ministry of Education and Culture (Permendikbud) No. 81A regarding curriculum implementation explains that the curriculum is developed with the intention of enabling the adjustment of educational programs in educational units to the conditions and peculiarities of the potential that exists in the learner's area. In addition, the 2013 curriculum allows direct learning experiences for students according to the background, characteristics, and abilities of the students. So, in this case it is very necessary to have a learning that focuses on students not only from teachers who give lectures or with conventional methods. In this case, it can be said that

the implementation of practicum is very important so that students can find answers and know learning materials from experiments and direct experience.

The teaching materials used by teachers are in the form of textbooks, worksheets, and sometimes also using power points, and it is allowed to use mobile phones to search for material on the internet. Teaching materials or learning media used by students must also be made as attractive as possible so that students become enthusiastic in learning and tend not to get bored. Therefore, interactive learning media can also be used in order to add insight and understanding of concepts and student learning motivation. Rani & Ahmad, (2018) suggested that interactive learning media can provide a positive response to students'

understanding of a learning material. Interactive learning materials also usually tend to be teaching materials that use information technology assistance.

The teacher also uses supporting media such as student worksheets, but the student worksheets are sourced from experiments from the Internet. The Student Worksheets used also only contain practice questions and theoretical testing. Meanwhile, in the 21st century, students are also required to be skilled in the use of technology. In terms of using technology, educators also said that the majority of students have smartphones that can be used if needed during learning for learning purposes and also so far educators have never used web-based Student Worksheets or STEM-based Student Worksheets with Scaffolding, but educators are very interested in holding such media.

One of the learning support media or teaching materials that can be applied is to use Student Worksheets in web form, where student worksheets are arranged based on curriculum needs and student worksheets can be used anywhere and anytime by students. In addition, educators are also better off using a special approach that follows the material needs of students, one of which is using the STEM and Scaffolding approaches to help students achieve a learning concept. According to Yanuardi & Permana (2019) STEM (Science, Technology, Engineering and Mathematics) education is currently a science learning option that can uphold a generation that is able to overcome the challenging 21st century. Beers in Pertiwi, et al (2017) also suggests that STEM learning is the unification of science, technology, engineering, and mathematics learning which is suggested to help advance 21st century skills. Scaffolding will also make it easier for students to understand certain materials that are considered difficult with certain assistance so that students' understanding of concepts will be better.

The purpose of the STEM approach is to increase students' understanding of how things can work and improve the use of technology by students, as well as introduce Engineering before going to college. Engineering is directly involved in problem solving and innovation. Students must learn about Engineering and develop skills and abilities that are in accordance with the Engineering Design Process (EDP) (DeJarnette, 2012). According to Septiani and Rutsman (2017) with performance appraisal in STEM education, we can assess each phase in the STEM approach. Performance assessment is equipped with STEM indicators aimed at assessing science process skills. With the indicators that are owned in the performance assessment, it allows the teacher to conduct an assessment during the learning process.

Thus, in order to provide an interactive, interesting, practical learning media, it can be used

anytime and anywhere, while it is hoped that it can improve students' scientific literacy, a product is produced in the form of a STEM-based student worksheet application on Elasticity and Hooke's Law material, where there are several product advantages, including: The resulting product is in the form of a STEM-Based Student Worksheet with Scaffolding on the material of Elasticity and Hooke's Law. This product has several advantages, namely; 1) The language is made easy to understand, 2) There are videos to further increase students' understanding of the learning material. Rasagama (2020) states that video is one type of learning media where the hearing and also the views of students can be interactive so that students can understand the content of knowledge material. 3) There are simple experiments that can be done by students at home/remotely, 4) There is a project making about Elasticity and Hooke's Law material that is in accordance with the latest developments and is STEM-based, 5) There is an evaluation.

## Conclusion

This study seeks to find a study of the needs analysis of teachers and students on learning media or teaching materials. The results of this study are used to develop a learning media product in the form of STEM-based student worksheets with scaffolding on the web. Teachers need an interactive learning media and attract students' interest in learning and can be used by students not only at school, while students need a learning media that is able to help students achieve learning concepts. Based on this, it can be used as a reference in the next development process, namely developing learning media in the form of STEM-based student worksheets with Scaffolding. The product is made in web form to be practical for students to use anywhere and anytime, the product is made with a STEM approach with scaffolding to suit current technological developments and can improve students' scientific literacy.

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