# Development of Ecosystem-Based Material Modules Discovery Learning with Media QR Scanner HP to Increase Problem Solving Skill (Class X Mipa 5 SMA Batik 1 Surakarta)

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**ABSTRACT:** This study aims to: 1) determine the characteristics of discovery learning- based modules with HP QR scanner media to improve students' problem-solving skills; 2) find out the feasibility of discovery learning-based modules with HP QR scanner media to improve students' problem-solving skills; 3) knowing the effectiveness of discovery learning-based modules with HP QR scanner media to improve students' problem-solving skills. This science learning tool development research uses the ADDIE procedure which consists of five stages, namely: 1) analysis, 2) design, 3) develop, 4) implementation, and 5) evaluation. The data analysis research instruments used were Aiken's descriptive analysis and validity (score 0.87 with high validity category) for preliminary and feasibility studies and inferential analysis using independent t-test (score 0.000) to determine the effectiveness of development products on students' problem-solving abilities. The study was conducted at SMA Batik 1 Surakarta with a sample of 32 grade X students. The conclusions of this study are: 1) the discovery learning-based module with HP QR scanner media developed has five main characteristics, namely: a) improving problem solving skills; b) concrete problem-based; c) student centered; d) discovery learning; and e) focusing on essential materials; 2) the discovery learning-based module with the developed HP QR scanner media was declared eligible (valid) for use in SMA/MA based on limited trial results and a validity score of 0.945 with a high validity category; 3) discovery learning-based modules with HP QR scanner media developed effectively improve students' problem- solving abilities, with an experimental class n-gain score of 0.504 (upper medium) and control class 0.360 (lower medium).

**KEYWORDS:** biology learning modules, discovery learning, ecosystems, problem-solving skills.

## INTRODUCTION

Education is one important factor in forming a quality individual (Pradana et al, 2020). One of the successes of a student's learning process is being able to solve problems encountered in everyday life (Santi et al, 2019). Problem solving ability is important to teach students (Cindikia et al, 2020). Problem solving skills are needed by students to solve problems appropriately, carefully, systematically, logically and effectively from various points of view.

Solutions to improve students' problem solving skills can be raised through learning activities carried out by the teacher (Huang et al, 2020). Students are invited to construct knowledge through problem-based discovery activities. Aspects of problem solving skills can be trained with the process discovery learning. According to (Fahmi et al, 2019) in the Discovery process (discovery) students will learn to think analytically and try to solve problems faced by themselves (independently), these habits will be transferred in social life.

Application discovery learning can also be applied through various learning elements. These learning elements include students, teachers, facilities and infrastructure, learning tools, learning media, and teaching materials (Simamora & Saragih, 2019). Learning media is one of the factors that can support learning in the classroom and outside the classroom so that it is more optimal (Puspitarini & Hanif, 2019). From the results of observations, the authors found that many teachers used various teaching media. SMA Batik 1 has also been using based media for a long time IT in learning. Many teachers are technologically literate IT. In this study the authors want to develop a learning model based QR scanning HP.

Utilization QR scanning even in the world of education it seems that we can try to apply it, especially for teachers of use QR Code You can try to use it as part of an effort to innovate learning technology, considering that currently the average student already has one smart phone. Based on interviews with subject teachers, it shows that teachers experience diffuculties in applying learning models, especially models discovery learning. Teachers are constrained in implementing the stages discovery learning too many, so short time, as well as managing students in class learning. Researchers several times use the help of the media QR with the application

in HP on the material book. On the other hand, class X Biology material books, in every material per KD, there is always an application QR which can be used to assist the learning process. The contents of the application are mostly in the form of interesting biology learning videos and can help students understand Biology material well.

Based on the description of the problem, situation analysis and potential of the HP QR scanner. For this reason, it is necessary to have teaching media with the help of QR HP to help the learning process based on discovery learning on the material An ecosystem to improve the problem-solving skills of class XI MIPA 5 SMA Batik 1 Surakarta.

## RESEARCH METHODS

This research is classified as development research (*Research and Development*). This research was conducted to produce a particular product, namely modules. The module that will be developed in this research is a biology-based module *Discovery learning* with media *QR QR Scanner HP* on Ecosystem material that is valid, practical, effective and powerful.

The preliminary research procedure, namely the initial research study, aims to analyze conditions related to the analysis of the learning process, analysis of teaching materials, and analysis of students' problem solving skills. Field studies are in the form of interviews or direct observation, where the researcher directly observes the object of research.

This development procedure uses the ADDIE model which includes *Analysis, Design, Development, Implementation, and Evaluation*. According to Aldoobie in the journal Budoya et al (2019) the ADDIE model is one of the most frequently used models to produce effective products. The flow of the ADDIE model can be seen in Figure 1.
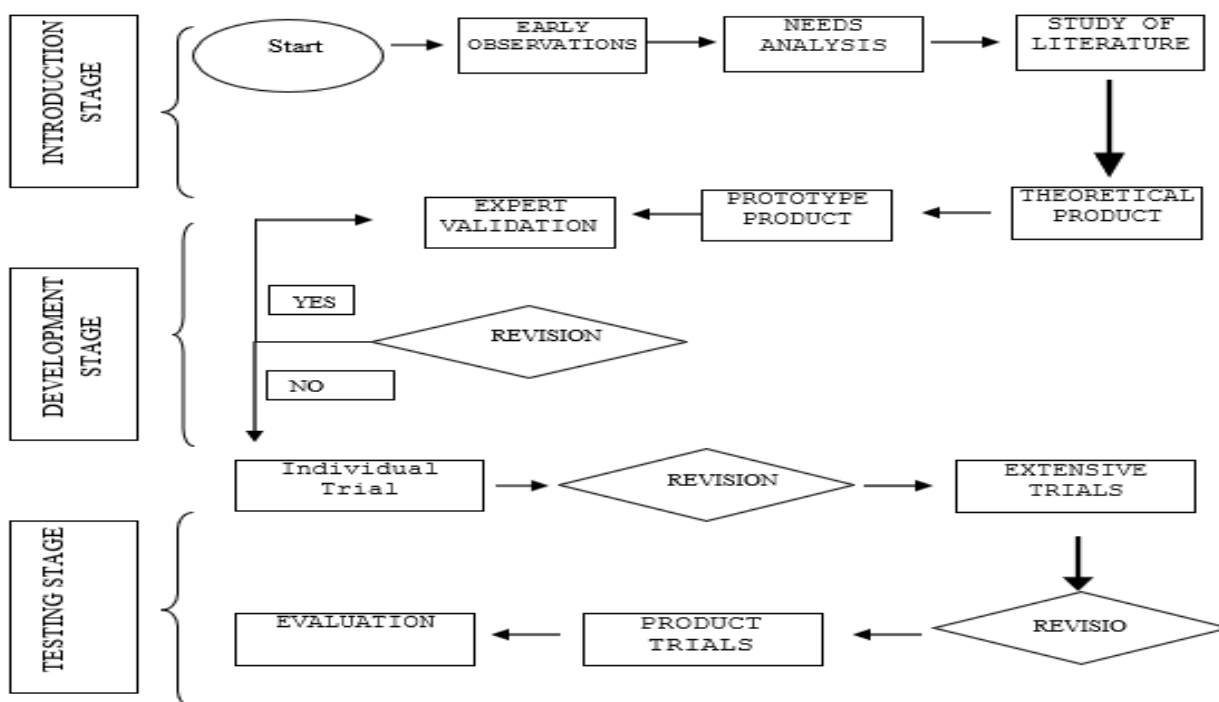


**Figure 1.** Development research flowchart

## RESEARCH RESULTS AND DISCUSSION
### A. *Characteristics of Based Learning Modules QR-Scanner*

Based on the analysis of the learning process including the learning tools that have been carried out, several main points are obtained that are of particular concern to the need for developing learning modules. There are 5 characteristics that are used as a reference in the development of Biology-based learning modules *discovery learning* with *QR-Scanner* on ecosystem material. The five characteristics are 1) improve problem solving skills; 2) based on concrete problems; 3)*discovery learning;* 4) *student centered,* and 5) focusing on essential material.

**Table 1.** The results of the analysis of student answers based on indicators of problem solving ability

| Indicator Problem solving skill | Average Score | Category |
|---|---|---|
| Understand the problem | 72,56 | Height |
| Plan problem solving | 59,45 | Enough |
| Solving problems according to plan | 70,13 | Height |
| Check again | 73,64 | Height |

Needs analysis data is shown in Table 1. Learning that is not student-centered makes students passive in the learning process, and only accepts information provided by teachers and books. Meaningful learning has not really been implemented in the Biology learning process, so that concrete application of Biology is difficult for students to understand. Not all students realize that Biology concepts are actually very close to our bodies and our daily lives.

Qualified student problem-solving abilities are the goal of developing this learning module. Apart from developing students' thinking skills, this is also in accordance with Kemdikbud (2020) which expects problem solving to be *output* in the distance learning process. Good problem-solving skills will become the basis for other thinking skills (Rahman, 2019). Problem solving ability is a capability based on the process of identifying problems, finding alternative solutions, and implementing the best solutions in relatively new situations (Araiza-Alba et al., 2021; Graesser et al., 2018). Meanwhile (Özreçberoğlu & Çağanağa, 2018) states that problem solving ability is the ability to solve all problems and make difficult decisions. (Rahman, 2019) defines problem solving ability as the ability to define problems, determine causes of problems, determine priorities, select various options for solutions and implement these solutions.

*Discovery learning* placing students as the center in the learning process and playing an active role in solving concrete problems cooperatively so that students can gain a deep understanding of the content they are learning (Hoidn & Reusser, 2020). In the context of use *discovery learning* as a teaching and learning method, students are placed as learning subjects, which means that students have a big hand in determining the atmosphere and learning model. Activities define and investigate a problem, formulate hypotheses, design experiments, collect data, and draw conclusions about the problem on *discovery learning* encourages every student to be actively involved in the teaching and learning process (Liu, 2021). Through these various activities, students gain direct real experience in biology-based learning *discovery learning* (Rusmalinda, 2021). By presenting problems or material content according to students' environmental situations, students will realize that what they are learning is important and can be applied to real life so that learning is more meaningful (Ulandari et al, 2019). So, even though learning is done online, students can still develop cognitive abilities through meaningful learning.

The focus on essential material is also one of the characteristics of the development of this module. The selection of learning by focusing on essential material aims to allow sufficient time for in-depth learning of basic competencies such as literacy and numeracy (Nurjanah et al, 2023). It is also intended that students can do activities *discovery learning* on target. Focus on essential material by leveraging activities *discovery learning* will provide in-depth learning about a learning topic (Hidayati & Wagiran, 2020).

**B. Feasibility of Based Learning ModulesQR-Scanner**
   **Validation Stage**

The feasibility of ecosystem-based material learning modules *discovery learning* with *QR-Scanner* determined based on the results of expert validation, namely linguists, media, materials, and learning as well as educational practitioners. The validation process is carried out by applying the questionnaire method. The validation results were analyzed using Aiken V presented in Table 2.

**Table 2.** Module validation results

| Aspect | Score | Criteria |
|---|---|---|
| Language | 0,97 | High validity |
| Media | 0,97 | High validity |
| Material | 0,72 | Moderate validity |
| Learning | 0,76 | Moderate validity |

Biology based module validation *QR-Scanner* conducted to assess the aspects of media, language, materials, learning processes and educational practitioners. The results of the media expert validation obtained an average value of 0.97, 0.97 for linguists, 0.72 for material experts, 0.76 for learning processes, all having a high validity category.

### *Limited Trial Phase and Wide Scale Test*
At the implementation or application stage, namely the application of development products on a limited scale.

**Table 3.** Implementation of limited trial learning

| Activity | | Execution | Notes |
|---|---|---|---|
| Meeting I | | | |
| Introduction | 100% | 79,46% | Timing and student readiness is necessary considered |
| Core | 62,50% | | |
| Closing | 75,00% | | |
| Meeting II | | | |
| Introduction | 100% | | Teachers need more conditioning time and conditioning students |
| Core | 83,82% | 86,60% | |
| Closing | 80,00% | | |

The limited trial phase was carried out by educational practitioners and a small group of users to assess the product in the form of a module-based *QR-Scanner*. Assessment of educational practitioners is carried out by teachers and small groups of users, namely students. The results of the assessment by educational practitioners on the development result module obtained a value of 0.94 with a very valid category and from a small group of users an average value of 0.95 was obtained with a high validity category. Suggestions and input from learning practitioners and small groups of users with several changes made based on the suggestions that have been given

Research data on a large-scale test consists of qualitative data and quantitative data. Qualitative data in the form of implementation of learning and revision of learning modules after trials. Meanwhile, quantitative data is in the form of scores on students' problem-solving ability test results. Qualitative data including reference data at the stage *implementation.* While the quantitative data is a reference for the effectiveness test which will be discussed and included in the stage *evaluation.* The results of observing the implementation of learning are shown in Table 4.

**Table 4.** Implementation of large-scale trial learning

| Activity | | Execution | Notes |
|---|---|---|---|
| Meeting I | | | |
| Introduction | 100% | 81,25% | Timing and student readiness is necessary considered |
| Core | 62,50% | | |
| Closing | 81,25% | | |
| Meeting II | | | |
| Introduction | 100% | 84,92% | Teachers need more conditioning time and conditioning students |
| Core | 73,52% | | |
| Closing | 81,25% | | |
| Meeting III | | | |
| Introduction | 100% | 85,00% | Teachers need more conditioning time and conditioning students |
| Core | 75,00% | | |
| Closing | 80,00% | | |
| Meeting IV | | | |
| Introduction | 100% | 88,97% | Teachers need more conditioning time and conditioning students |
| Core | 79,41% | | |
| Closing | 87,50% | | |
| V meeting | | | |
| Introduction | 100% | 90,44% | Teachers need more conditioning time and conditioning students |
| Core | 83,82% | | |
| Closing | 87,50% | | |
| VI meeting | | | |
| Introduction | 100% | 94,97% | Teachers need more conditioning time and conditioning students |
| Core | 91,17% | | |
| Closing | 93,75% | | |

In the wide-scale test stage for the feasibility stage it is focused on the implementation of learning from students using the learning process and product development results. The average result of learning implementation for six times obtained a value of 87.59% in the very good category.

Based on the results of the three stages, namely validation by experts, limited trials, and large-scale tests, it can be concluded that the module is based *QR Scanner* which is developed is suitable for use in educational units and becomes an alternative module in learning *online* which is able to display a more real visualization and can facilitate students in solving problems. In line with research by Alyusfitri et al., (2023); Ameriza & Jalinus, (2021); Pratiwi & Indana, (2022); Setyawan & Nawangsari, (2021) which classifies the validity of the e-module based on the results of expert evaluations, with the results obtained that the e-module can be used properly and can help students understand the material.

## C. The Effectiveness of Based Learning ModulesQR-Scanner

The steps of the scientific method are listed in the learning model *discovery learning*. *Discovery learning* is a learning model focus on on the activities of students in learning. This means that students focus on finding their own ideas and taking their own meaning. Discovery learning tends to ask students to make observations, formulate problems, formulate hypotheses, and collect data, process data, analyze data, draw conclusions and communicate, or scientific actions to get conclusions from the results of these scientific actions. With discovery learning, students can learn independently and in groups with the scientific process through the stages of observing, questioning, trying, reasoning, and communicating (Murtiyasa & Al Karomah, 2020). This learning model emphasizes the teacher to give problems to students and then students are told to solve these problems. In short, models *Discovery Learning* used in this research because the concept discovery process is formed and developed through a scientific process that involves investigative or experimental activities as part of scientific performance. *Discovery Learning*, which has steps of the scientific method, trains students to think systematically, logically, orderly, and thoroughly. Systematic, logical, orderly, and thorough thinking is the basis of problem solving abilities. So, *Discovery Learning* able to practice problem solving skills.

**Table 5.** Score analysis *posttest* problem solving abilities of experimental and control classes

| No. | Test | Results | Conclusion |
|-----|------|---------|------------|
| 1 | Normality (Shapiro-Wilk) | Experimental class problem solving ability score $(0.129 > 0.05)$ Control class problem solving ability score $(0{,}547 > 0{,}05)$ | Data is normally distributed |
| 2 | Homogeneity (Levene Test) | Scores of problem solving abilities of the experimental and control classes $(0{,}450 > 0{,}05)$ | Homogeneous data |
| 3 | Ujit *(Independent Sample T test)* | Scores of problem solving abilities of the experimental and control classes $(0{,}000 > 0{,}05)$ | H0 rejected (there is a significant difference between the problem-solving ability scores on experimental and control class |
| 4 | Uji n-gain | Score *pretest* and *posttest* experimental class problem solving ability is 0.504 | Upper medium |

The results of the t-test in Table 5. show that there is a significant difference between the problem solving ability scores in the experimental class and the control class. N-gain also shows that the experimental class has scores in the upper medium category,

while the control class has scores in the lower medium category. The experimental class carried out the learning process using modules *QR Scanner* ecosystem based material *discovery learning*. Meanwhile, the control class carried out the learning process using the lecture method and used modules commonly used in schools. In other words, the modules developed effectively improve the problem solving abilities of students. Experimental class students are more trained to think systematically, logically, regularly and thoroughly through activities of collecting data, analyzing information, and choosing the most effective way of solving or alternative solutions (Maknun, 2020).

Subject Biology is developed through the ability to think analytically, inductively and deductively to solve problems related to natural events around it. Solving problems that are qualitative and quantitative is done by using understanding in the fields of mathematics, physics, chemistry, and other supporting knowledge. Biology-based learning activities *discovery learning* which has been developed in this study has characteristics that can improve problem solving abilities. The problems presented (the need to know the ecosystem around each student's home) make students interested in carrying out investigations, testing with worksheets, evaluating, and drawing conclusions. With experiences like this, students are unconsciously invited to activate their thinking skills, one of which is problem solving. The Covid-19 pandemic situation, which forced students to limit learning activities and processes at home, made the learning activities developed in this study more meaningful. Even though learning is carried out *online* through the application *zoom meeting* or *google classroom,* students can still carry out learning activities that train the activity of high-level thought processes.

Student worksheets (LKS) that students work on are structured to practice problem-solving skills. This worksheet is divided into several activities, both to find the concept of ecosystem components, energy flow, as well as biogeochemical cycles and succession. The LKPD is designed according to the content of the garden in the neighborhood around the house as well as the learning stages that are able to guide students through a series of scientific investigations. students make observations of ecosystems from analyzing problems, formulating hypotheses, testing hypotheses, making conclusions, to being able to find the truth of a knowledge. Alam et al. (2019) argues that teaching using worksheets with appropriate learning stages has a positive effect on students' thinking abilities. Utilization of the garden in the neighborhood around the house as a source of scientific research aims to display real natural phenomena around students so that it is easier to carry out analysis and evaluation, and it is easier to understand the truth of knowledge based on correspondence theory with inductive thinking lines. Ummah & Yuliati (2020) revealed that the problem solving process is an important element for students in combining real life problems. So that with the incorporation of problems into real life, students will be able to solve problems, especially existing ones in life everyday with ease.

The environment that has the potential as a learning resource makes a major contribution to students in the learning process. The existence of concrete learning resources combined with appropriate learning models can help students understand the concepts to be taught (Ilma & Wijarini, 2018). Hermino & Arifin. (2020) stated that the form of integration of learning materials that are appropriate to the surrounding environment can make it easier for students to find their own concepts learned with direct experience. Ardan (2018) support that environment-based learning is able to train students' thinking processes. The existence of a concrete environment in the learning process has an effect on the closeness between the object being taught and the learner.

Research related to the use of module-based *QR Scanner* with models *discovery learning* on ecosystem material gives a pretty good influence on improving students' problem-solving abilities. The ecosystem in this study focuses on the garden ecosystem in the environment around the student's house. The results of this study are supported by research by Amelia & Sukma, (2021); Bahtiar et al., (2022); Jafria et al., (2023); Salmi, (2019) which one shows students get a positive influence from the model *discovery learning* in terms of additional learning resources, problem-solving abilities, and fun learning experiences.

## CONCLUSION

Based on the results of the research and development that has been carried out, several conclusions can be drawn as follows:

1. based module *discovery learning* with media *QR scanner HP* developed has five main characteristics, namely: a) improve problem solving abilities; b) based on concrete problems; c)*student centered,* d) *discovery learning*; and e) focusing on essential material.
2. based module *discovery learning* with media *QR scanner HP* developed is declared feasible and valid for use in SMA/MA. Validation by experts and educational practitioners carried out on learning products using Aiken V average of 0.87 indicates a level of validity in the high category.

3. based module *discovery learning* with media *QR scanner HP* declared effective for improving the problem solving abilities of SMA/MA students. There is a significant average difference in the problem solving abilities of students whose learning uses based module *discovery learning* with media *QR scanner HP* (experimental class) with a class that does not use based module *discovery learning* with media *QR scanner HP* (control class).*N-gain* score *pretest* and *posttest* the problem solving ability of the experimental class is 0.504 (upper medium) while the control class is 0.360 (lower medium).

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