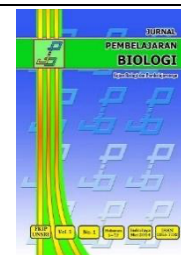


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The Development of *Vertiminaponik* Learning Tool Integrated Livestock For Enhancing Student Creative Thinking Skills in Biology learning

Ferry Irawan^{1*}, Rival Hanip²^{1,2} Faculty of Teacher Training and Education, Universitas Musamus, Merauke, Indonesia.**Article History:**

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Keyword:learning tool
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creative thinking skills**Abstract:**

One of the skills that must be possessed by students is creative thinking skills that are oriented towards the ability of students to think metaphorically. To support this in Biology learning, innovative learning media are needed, namely vertiminaponik learning media which are learning media that integrate plant, livestock, and fish cultivation that direct students to understand each related material. This research is the development or Research and Development (R & D). Development models used in this research is the development of ADDIE model. This model consists of six stages of activity, namely: 1) concept analysis, 2) design, 3) the collection of material, 4) development, 5) implementation, and 6) evaluation. The purpose of this study was to produce a learning tool vertiminaponik that are valid, practical and effective. Assessment instrument consisting of three, namely: a) the instrument validity in the form of an assessment instrument validity learning tool vertiminaponik integrated livestock and assessment instruments validity of worksheets learners b) Instruments practicality in the form of an assessment instrument practicality and c) assessment instruments effectiveness learning tool vertiminaponik. Practicality Vertiminaponik based learning tool development obtained high category. Previously, validity and reliability tests were carried out on the questionnaire consisting of several sub-indicators covering the components of the vertiminaponik learning media to determine the effectiveness and practicality of the media, and each component of the instrument was measured using the product moment test in the SPSS application. Based on the results of this study concluded that a learning tool vertiminaponik terintegrasi farms are valid, practical and effective.

Corresponding Author

Author Name*: Ferry Irawan

Email*: irawanferry2029@unmus.ac.id

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Introduction

In this information era, the use of technology in education cannot be avoided, therefore, teachers are required to implement technology-based learning by using a scientific approach as contained in the curriculum (Hammershøj, 2021). Creative thinking skills is the improvement mindset, strengthening governance curriculum, deepening and expansion of the leaning material, reinforcement learning, and learning load adjustment in order to ensure conformity between what is desirable and what is produced.

Pattern of creative thinking skills is implemented on the basis of a few key principles. First, competency standard is derived from necessity. Second, content standard is derived from competency standard through its main competencies-free subjects (Irawan, 2023). Third, all subjects should contribute to the formation of attitudes, skills, and knowledge of learners. Fourth, subjects are derived from the competency. Fifth, all subjects are bound by main competencies. Sixth, the alignment demands graduates, content, learning processes, and assessment. Therefore we need a tool or media that is both practical and efficient way to help the learning process (Albert, 2020).

In biology learning, creative thinking skills can be trained dynamically in students when they encounter real problems and phenomena in the learning process, one of which is integrated

with agricultural cultivation that can be done anywhere, ranging from rice paddies, fields, gardens, and can also be done in the yard near the residence, and in urban areas (Irawan et al., 2023) Urban plantings by utilizing the yard of the house as one of the activities are expected to tackle the problem crops for people who have limited land so the family food needs can be fulfilled at least partially independently (Marrero-Rodríguez et al., 2022).

There are several different ways of farming that is suitable and already widely known in the community, including the vertiminaponik. (Irawan, 2024) Vertiminaponik system can simply be defined as a system of crop planting which is done vertically. Vertiminaponik is cultivated by combining the cultivation of aquatic animals (usually fish) with cultivated plants. In vertiminaponik system, the same land area can produce two commodities at the same time, the plants (usually vegetables) and fish with abundant harvests (Rocky, 2022).

Vertiminaponik also be categorized as one of the modern intercropping systems that combines the cultivation of horticultural crops which are usually in the form of vegetables and fish farming that arranged vertically, and combines with breeding cattle, where cattle dung used as feed for fish. Commonly cultivated fish are freshwater fish that need oxygen are not too many (Saenab et al., 2021).

The scientific approach is the development of attitudes, skills, and knowledge of learners. So with the development vertiminaponik as learning media certainly assist students greatly to improve students' learning skills. Learning to approach scientific is learning that consists of the activities observed (to identify the things they want to know) (Goodyear & Armour, 2021). formulate questions (and formulate hypotheses) try / collect data (information) with various techniques, associate / analyze / process the data (information) and draw conclusions and communicate the results of which consisted of the conclusions to acquire the knowledge, skills and attitudes (Ningsi et al., 2019).

In a scientific approach or work process that meets the scientific criteria, the inductive reasoning compared with deductive reasoning. To improve the process of strengthening the learning by using a scientific approach, which is integrated in every basic competences as the implication of meaningful learning, it is indispensable learning tool to support learning and reasoning skills of students.

In the process of learning, it is often encountered various kinds of constraints one of the most frequently encounter is lack of learning tools that support teaching and learning activities which is characterized by a sense of intending to know, to improve the process of students of every learning activity undertaken. To support teaching and learning activities, learning tools is necessary that is relevant and innovative nature (Irawan, 2023).

Vertiminaponik learning tool can be used students to carry out practical work and also can be used as a task portfolios or worksheet consists of several components that are adjusted to the sub-indicators of creative thinking skills. The first worksheet is adjusted to the scope of the material consisting of several practice questions that are loaded systematically. The next component is the project assignment which is used as a means to train students' abilities in solving problems related to scientific phenomena. In addition, there are weekly notes on the worksheet to determine the frequency of students' understanding of the material after learning using vertiminaponik learning media.

For learners, especially on basic competencies At the main competence in the learning process that is sensitive and concerned about environmental issues, maintaining and caring for the environment as a manifestation of the practice of the teachings of their religion. Standar competence behave scientifically: (Hammershøj, 2021).conscientious, diligent, honest to data and facts, discipline, responsibility, and care in observation and experimentation, daring and polite in asking questions and arguing, environmental care, mutual aid, cooperation, love peace, argue scientifically and critically, responsive and proactive in every action and in conducting observations and experiments in the classroom / laboratory and outside the classroom / laboratory (Irawan et al., 2024).

Basic competence play important role to analyze the relationship between the internal and external factors with the growth and development of living organisms based on the experimental results, and standard competence that planning and carrying out an experiment on the outside factors that affect the growth and development of plants, and report writing using the correct procedure for scientific writing, so students can be able to create an integrated vertiminaponik learning tool farms and create tasks using learning inquiry related to growth and development of living things (Thahery & Mahaputra Riau, 2023).

The vertiminaponik learning media that was developed is integrated with livestock farming, and livestock waste is channeled into plant pipes to become a supply for plant growth, and this is an innovation that has a uniqueness that differentiates it from vertiminaponik learning media in general. Based on vertiminaponik learning tool, Worksheet election based inquiry learning is due vertiminaponik learning tool has an innovative learning process which is supported by the inquiry worksheet based guided learning. Based on the matters above, the researchers intended to

conduct research with the title "The Development of Vertiminaponik Learning Tool Integrated Farm for Implementation Creative thinking skills.

Method

Type of R & D (Research and Development), which includes the development of vertiminaponik as learning tools and worksheets for students (LKPD) based curriculum in 2013. This research was conducted in the laboratory of the Laboratory of Experimental Garden of Biology, Faculty of Mathematics and Natural Sciences, University of Makassar from September until March 2024. Vertiminaponik development follows the contours of the model development are Luther over six (6) phases: Concept, Design, Collection Equipment and Materials, Manufacture, Validation, Repair, and The effectiveness Practicality Test, Distribution. Here Luther plot development models that have been modified

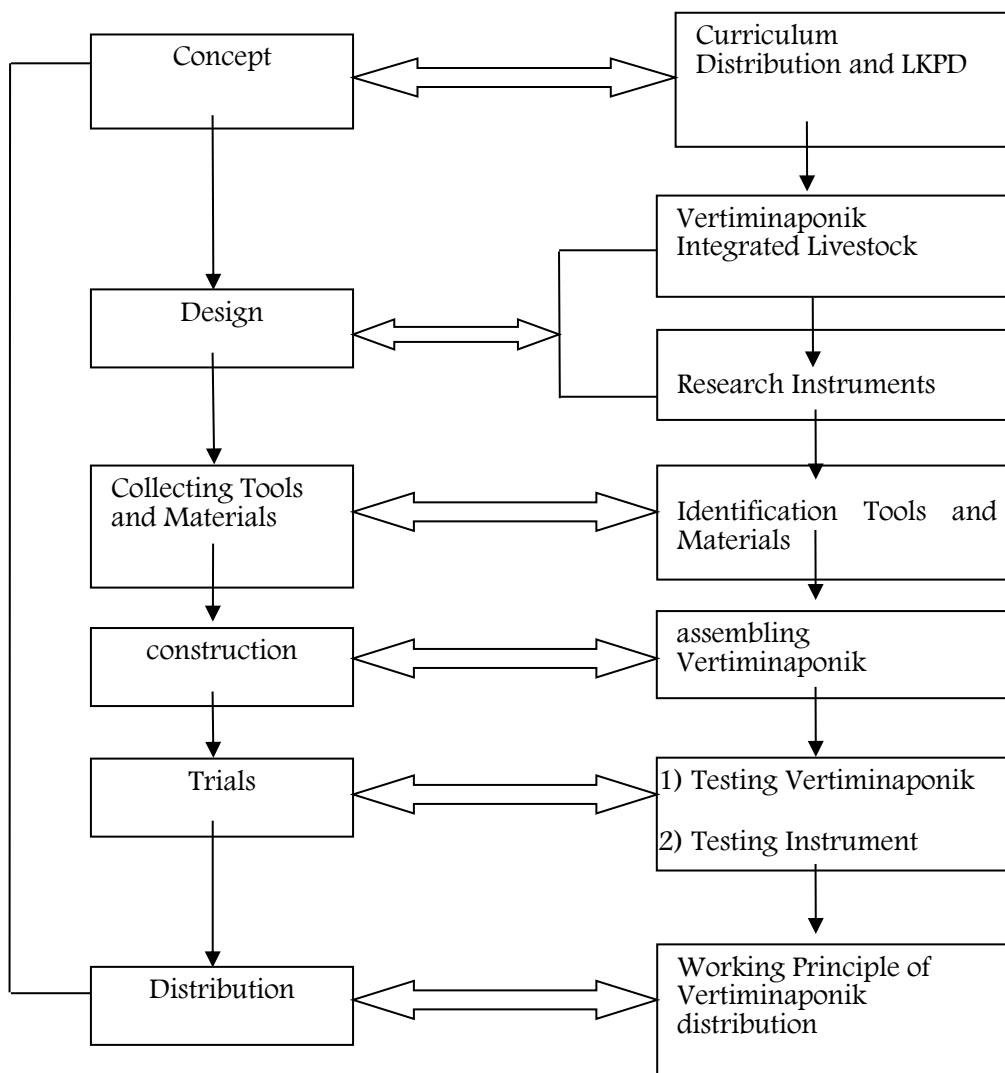


Figure 1. ADDIE Development Model that has been modified

1. Concept analysis

At this stage, the selected concept that is based on the Curriculum to enhance meaningful learning, to develop vertiminaponik learning tools installation as an environmentally friendly learning tool. Concept analysis is related to the initial needs analysis conducted to find out the meaningful learning process that is able to lead students to achieve learning goals comprehensively and holistically. The initial needs analysis revealed that in the learning process there were still several shortcomings so that the learning activities carried out were not yet sufficiently focused.

2. Design

Design vertiminaponik plants tools installation by observing the principles of integrated farming system that is integrated with fisheries. This is done to look at the relationship of the two. In this design, the shape of pomfret fishery combined with water spinach plants. Hydroponics growth Nutrients of plant is derived from animal sources (manila) and catfish that are supplied with engine water pump pipe passing through the cavity that has been provided. This design is based on the principal of relationship nutrients needed for plant growth that are derived from and the fish in the water. In addition, there is also a filtration that will filter the water so that the pond will clear

3. Development

In this step, the validity test was held and evaluated by validators which resulted in repairing the installation of an integrated fish culture hydroponics system or vertiminaponik tool system as the learning tool which its improvement based on the design steps. Further, the researcher would re-design the installation, collect materilas, and re-assemble. After that, include Repair the installation design based on validators' critics and suggestion. Component improvements after the manufacturing process is carried out are the initial step in determining the components that must be involved in compiling learning tools that are adapted to basic school needs that refer to the curriculum objectives to create a meaningful learning process.

4. Implementation

After the installation of an integrated fish culture hydroponics system improvement was valid, then validity and practical test would be held as the learning tool, but still there were some parts needed to be reconstructed.

5. Evaluation

In this step, the researcher distributed Students' Work Sheets (*Lembar Kerja Peserta Didik / LKPD*) into high schools and to be straightly applied in the school environment which based on Curriculum to enhance cretive thinking skills and thought The procedure used the following research instruments: expert validation questionnaire, practicality questionnaire, and effectiveness questionnaire. The characteristics on each questionnaire can be seen on the table below.

Table 1 The Characteristics of Research Questionnaires

Questionnaire Types		Objectives
Expert Questionnaire	Validation	Validation by experts
Practicality Questionnaire		The practicality or easy to use
Effectiveness Questionnaire		The effectiveness which proved by the well growth of catfish and leafy vegetable

Result

The result of tool validation in integrated vertiminaponik with fish culture/husbandry by pedagogical basic as the main component of menaingfull learning, and The average result of tool validation in integrated vertiminaponik with fish culture/husbandry by pedagogical basic to support cretive thinking skills.

Table 2. Indicator descriptions

No	Description	\bar{X}	R	Inf.
1	Vertiminaponik learning tool is relevant with Creative thinking skills and Curriculum	5	1	HV/R
2	Vertiminaponik learning tool is relevant with the development pattern of Curriculum.	4,67	1	V/R
3	Vertiminaponik learning tool is suitable for scientific approach as the work process involving with scientific criteria completion.	5	1	HV/R
4	Vertiminaponik learning tool is relevant to strengthen the learning process.	5	1	HV/R

No	Description	\bar{X}	R	Inf.
5	Vertiminaponik learning tool is relevant for students' developing, behaviour gaining, ability, and knowledge through learning process strengthening.	5	1	HV/R
Average		4,93	1	V/R

Information: HV= High Validity, V = Valid, R= Reliability, \bar{X} = Average

Based on Table 4.8 the average result of tool validation in integrated vertiminaponik with fish culture/husbandry by pedagogical basic obtained average scores (\bar{X}) of 4,93. The assessment criterion ranged from $4 \leq Va < 5$ = Valid. So, the integrated vertiminaponik with fish culture/husbandry by pedagogical basic proved as valid. There was also reliability test. In the table 4.8, the average reliability obtained from integrated vertiminaponik with fish culture/husbandry by pedagogical basic: 1. The assessment criterion $R > 0,75$ = Reliable. Moreover, the instrument validation on integrated vertiminaponik with fish culture/husbandry by pedagogical basic proved as reliable. Thus, the results of the validity and reliability tests of each component and learning media design have met the valid and reliable requirements so that the dissemination process can be carried out.

Design vertiminaponik plants tools installation by observing the principles of integrated farming system that is integrated with fisheries. This is done to look at the relationship of the two. In this design, the shape of pomfret fishery combined with water spinach plants. Hydroponics growth Nutrients of plant is derived from animal sources (manila) and catfish that are supplied with engine water pump pipe passing through the cavity that has been provided. This design is based on the principal of relationship nutrients needed for plant growth that are derived from manure (manila) and the fish in the water. In addition, there is also a filtration that will filter the water so that the pond will clear. As for the design:

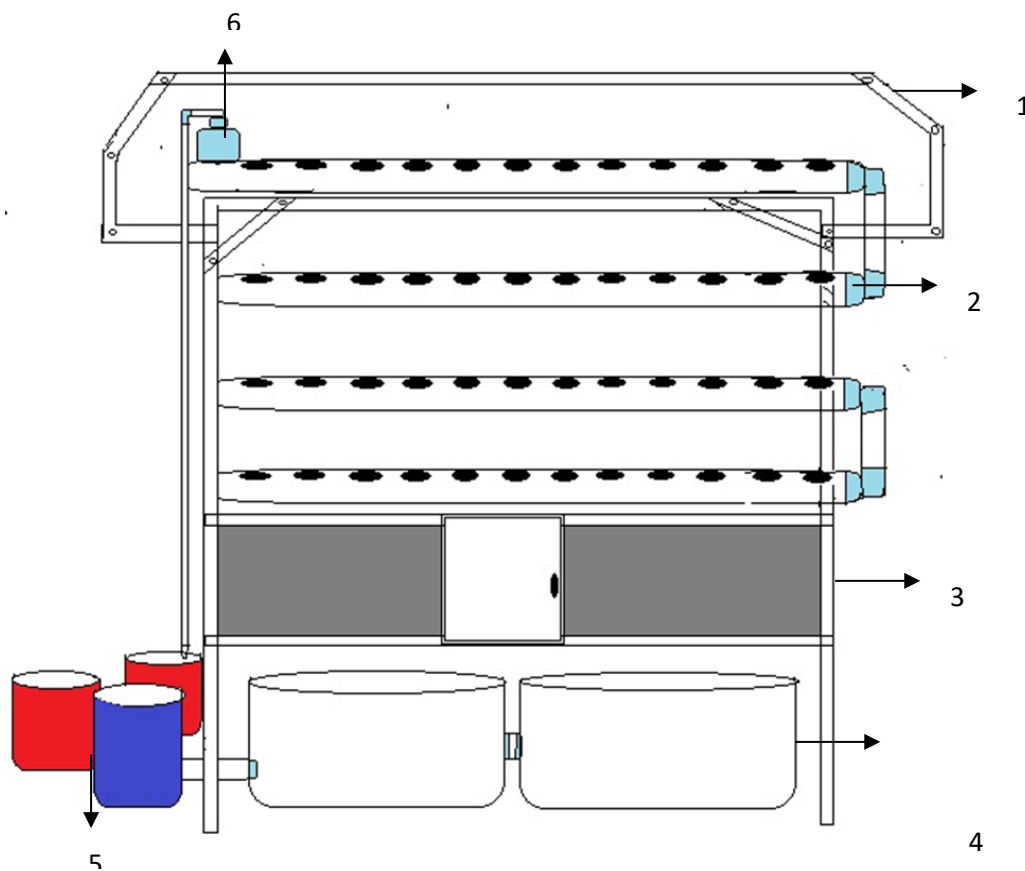


Figure 2. Side View of *Vertiminaponik* Design

Based on the design image, the components of each alt used in developing vertiminaponik learning media are visible. This design is in accordance with the results of the initial analysis in the procedural development of the vertiminaponik learning media design.

Information:

1. The roof installation
2. Plant Pipes
3. Animal cage
4. fish pond
5. filtering
6. The connection pipe of water flow

Discussion

In this research, there has been an improvement on the integrated Vertiminaponik and fish culture with the improvement of Students' Work Sheets (*LKPD*) based on inquiry learning to support creative thinking skills. The concept was reviewed on the improvement of integrated Vertiminaponik and fish culture with the improvement of Students' Work Sheets (*LKPD*) based on inquiry learning by literature reviews and relevant findings. The reviews were described in the related literature of this research. Here is the following figure about the result of concept analysis based on Curriculum of its Standard Competency (*Kompetensi Inti/KI*) and Basic Competence (*Kompetensi Dasar/KD*) on Biology Subject.

The improvement of integrated Vertiminaponik and fish culture with Students' Work Sheets (*LKPD*) aimed to prepare a learning tool which can be implemented in Biology Subject in high schools, especially in first standard competence that is fully comprehend and carry out the religion chosen with devotion, the second standard competence which fully comprehend and being honest, discipline, responsible, sympathy (cooperative, tolerant, peaceful), well-mannered, responsive, pro-active, and show some attitude as the part of solution offered facing various problems as the effective interaction with social and natural environment and as a self-nation in world society (Wolfowicz et al., 2021).

Through vertiminaponik learning media, students are facilitated to understand all factual problems and they are trained to think originally in solving problems because through vertiminaponik learning media, students directly learn about the concepts they are studying and they can provide scientific arguments and creative thinking skills from the results of observations or practical activities in learning process.

The main uniqueness of vertiminaponik learning media is that students train their intuition towards their understanding of the biology learning process. One example is in the material on plant growth and development, students will be trained to think metaphorically to see how vegetable cultivation in learning media can grow well after receiving supplies from livestock manure and animal manure, this simultaneously trains students' creative thinking skills in associating scientific concepts and understanding.

This is supported by relevant research which suggests that creative thinking skills can be trained simultaneously if students are continuously facilitated to understand the derivation of various concepts, from these derivations they are able to express their respective opinions which are the results of original thinking so that they are able to unite several concepts after carrying out understanding or observation activities that are oriented by using a scientific approach through the use of unique and innovative learning media (Irawan et al., 2024).

The next standard competency fully understand, apply, analyse, and evaluated factual knowledge, conceptual, procedural, metacognitive based on curiosity in science, technology, art, culture, (Aldahmash & Omar, 2021) and also humanities with humanism concept, nationality, states, and civilization due to current phenomena and events, also to adjust procedural knowledge on specific skill and interest to solve problems, and the fourth standard competence to process, think, present, and create concrete and abstract due the independent improvement gained in school, also act effectively and creatively, and able to use method regarding the scientific norms (Behnamnia et al., 2020).

The design of integrated Vertiminaponik with fish culture was combined with the aquaponics and hydroponics which systematically integrated with the husbandry. The tool provided an interaction space between aquaponics and hydroponics system. The interaction patterns occurred through waste excretion produced by Nile Tilapia fish which flowed into a pool fish and the connecting pump with the instruction of Vertiminaponik system. Waste excretion of the fish which contaminating water became food for fish then excreted and flowed into the plant through the fuse on the hung flanel material from the below surface of net pot as the plant container. By it, the plant got the nutrition from waste excretion of the fish. (Putra & Rahman, 2019).

The secretion substance produced by fish generally is ammonia (NH_4). It is known that ammonia (NH_4) can be a toxic for plant. That is why we need decomposition which in this

Vertiminaponik system added by probiotics (*Acetobacter sp*) contains of decomposed bacteria that can turn the ammonia into nitrate and nitrite for the plant. The concept has a strong relation with the material, especially for nitrogen cycle. (Park & Antonio, 2021) The water circulated into the aquaponics system where the nutrition produced by fish secretion were flowed to the plant through pumps and the dangerous nitrogen compound for fish can be absorbed by the plant which become nutrition for it. Through the hydroponics system, the water were neutralized and aerated before turning back into the Vertiminaponik system. (Tari et al., 2022)

The first step of designing LKPD is deciding the title which then arranged and collecting references from various sources in the form of textbooks, scientific journals, or articles. The references was analyzed based on the procedures (according to the standard and basic competences). Moreover, we started to write the contents of LKPD which contains the following main components: (1) Cover which includes title and the contents of LKPD; (2) The preface includes material, theme, duration, and basic competences; (3) Contains material summary which includes students' participation in observing biology objects, basic questions involving the biology material and matters, and as the information source (4) the implementation includes tool, material, worksteps, notes, task division in group, and the schedules of project events which reported orally and in written form. Oral report by presentation and written report by portfolio using LKPD form based on learning inquiry.

Effectiveness test of an integrated vertiminaponik learning tool farm consists of measurement data growth and development of green kale plants (aquatic Ipomoea), the duck broiler livestock growth, and growth in catfish.. Data evaluating the effectiveness of learning tools based on growth kale vertiminaponik water (aquatic Ipomoea) consists of aspects of germination, plant height and leaf area. While the growth of livestock based on the weight of livestock namely ducks, as well as the growth of catfish (Putra & Rahman, 2019)

It shown that plants begin to germinate on the first day until day 5 and was shown also that all the seeds were sown in 132 net pot began to germinate on day two to day five. In addition to the measurement of germination, plant height data was shown ialso shows good growth of green kale, as well as with broad leaves. Based on this, integrated vertiminaponik learning tools farm was considered effective as a learning tool.

In addition to measure the data of water spinach, also shown the measurement catfish data (*Clarias scopolli*). In the measurement data showed the growth of tilapia reared at the farm integrated vertiminaponik system to take advantage of manure as feed, showing the length of fish were excellent. Data presented on the length of the fish may also indicate that vertiminaponik learning tool can be considered as effective.

Data speed of seed germination kale, growth of plant height and leaf area on the plant kale, long catfish, weight gain ducks reared on vertiminaponik learning tool, very conducive for students to conduct trials on the growth response of animals and plants with vertiminaponik system by linking it to the influence of external factors to the growth and development of living things, especially plants and fish as well as a written report on their observations.

This was according to the basic to analyze the relationship between the internal and external factors with the growth and development of living things by the results of experiments and basic competence was planning and carrying out an experiment on the outside factors that affect the process plant growth and development, and report writing using the correct procedure for scientific writing.

Conclusion

Based on the design image, the components of each alt used in developing vertiminaponik learning media are visible. This design is in accordance with the results of the initial analysis in the procedural development of the vertiminaponik learning media design, thought argues scientifically and critically, responsive and proactive in every action and in conducting observations and experiments in the classroom / laboratory and outside the classroom / laboratory.

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