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Potential development of field activity design on ecology material as student learning material

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ABSTRACT

This study aims to analyze the design of laboratory activities (DKL) for field trips activities in the Ranca Upas heterogeneous forest and to provide solutions through reconstruction. The significance of using the field trip method to enhance student learning outcomes and environmental awareness. The Ranca Upas heterogeneous forest was chosen as a field trip location because it has high micro-diversity and abundance. The DKL was designed to examine the interaction between biotic and abiotic factors as well as the inter-component interactions in the heterogeneous forest. This study employed a qualitative descriptive method utilizing the Analyze, Create, Try, and Reconstruct framework. A survey of the forest locations served as the basis for developing the DKL. The design of the DKL was informed by the survey results and analyzed using the Novak-Gowin Vee Diagram rubric. A trial was conducted to assess the suitability of the DKL in real field conditions. The results of this trial were then analyzed, leading to a reconstruction of the DKL based on challenges encountered during the trial. The reconstruction process included refining the tools used, preparing more structured activity steps, and developing more comprehensive practicum questions. This research has implications for the development of higher-quality and more effective field trip DKLs, ultimately aimed at improving students' science process skills and critical thinking abilities.

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INTRODUCTION

Learning methods are techniques used to teach students so that students gain understanding and skills through the learning process (Widodo, 2021). Learning with the correct method can increase learning motivation (Aziz & Shaleh, 2019). The proper method can also improve student understanding (Hamid, 2019). Kisiel (2003) argues that in the learning process, students need to be invited outside the classroom to review other places or objects to have a direct experience. Students can achieve optimal learning outcomes when they understand lessons well through direct experience (Widia et al., 2016). Learning outside the classroom that makes students one with nature and makes observations of objects in the surrounding environment can encourage motivation and make students more active (Dewi, 2021). One of the learning methods that requires students to get out of school is a *field trip* (Kisiel, 2003).

Field trips are a learning method that directly takes students to locations relevant to the studied material. Thus, learning is done in the classroom and through practical experience in the field (Hindayati, 2023). Bassaw et al. (2022) describe *field trips* as students' experiences outside the classroom in interactive locations designed for educational purposes. Widia et al. (2021) state that the *field trip* method can empower all student potential, encourage creativity, create a fun learning atmosphere, and provide diverse learning experiences. *Field trips* can also improve student learning outcomes in environmental management materials for junior high school students (Marini et al., 2016). The *field trip* method on biodiversity material has proven effective in increasing student awareness of biodiversity values (Nurhasnah et al., 2019). According to research by Mu'minah et al. (2023), *field trips* to the arboretum forest can significantly improve learning outcomes on plant identification material. The *field trip* method is considered adequate because of students' involvement in directly observing everything in the field (Muchsin et al., 2021). Hill (2013) said that student participation in *field trip* learning not only has an impact on increasing biology achievement scores but also increases environmental awareness, affective (interpersonal and positive behavior), and pro-environmental attitudes that lead to environmentally sound and responsible citizens and can lead to decision making to deal with various environmental problems that arise in the 21st century (Hill, 2013).

Wilson in Ezechi (2018) says *field trips* offer students many meaningful educational opportunities. These opportunities are as follows: 1) *field trips* provide authentic learning experiences to students because they allow them to practice what they learn through other teaching methods; 2) *Field trip* activities allow students to see the world (its culture, diversity, and reality firsthand; 3) biology field trips allow students to collect accurate ecological data; 4) When students go out and study in groups during *field trips*, their interpersonal relationships improve as they learn to live and work with others, supporting each other during group learning activities, and 5) *field trips* improve students' memory as students are proven to be able to remember what they learned on the trip for years.

One of the ecosystems that can be used as a *field trip* location is a forest. According to Law No. 41 of 1999 concerning Forestry, a Forest is an ecosystem consisting of an expanse of land containing biological natural resources, which are dominated by trees in their environment and cannot be separated from one another. Forests can be a *field trip* location in biology subject matter of biodiversity. One of the forests that can be used as a *field trip* location is the Ranca Upas heterogeneous forest. A heterogeneous forest is characterized by diverse tree species (Department of Environment, 2019). This type of forest serves as an excellent ecosystem for environment-based learning. The high micro-diversity and abundance found in heterogeneous forests make them particularly valuable. These forests contain numerous micro-habitats, each primarily inhabited by specific plant species. (Wiryono, 2020; Purnama et al., 2022).

Biology, one of the science studies, is closely related to natural phenomena, so nature itself can be a laboratory that provides various phenomena that are in line with biology-related studies, one of which is the forest. Thus, the forest is where experiments and investigations about biology subjects can occur. Laboratory or practicum activities are closely related to the design of laboratory activities (DKL). The design of laboratory activities is usually in the form of student worksheets (LKS). LKS contains information and instructions from teachers to students to carry out learning activities through work, practice, or applying concepts learned to achieve specific goals (Safriandono & Charis, 2014). However, there are still many DKLs that are not of good quality. As in the research of Lestari et al. (2021), it was found that some DKL samples still had cognitive problems, practical problems, and knowledge construction problems, and no DKL had the maximum score with vee diagram analysis. The mismatch of activities with work steps can also make learning ineffective and inefficient (Rozaq & Kocimaheni, 2020). Therefore, this study aims to analyze the design of laboratory activities (DKL) on field trip activities in the heterogeneous forest of Ranca Upas and then provide solutions in the form of reconstruction.

METHOD

The method used in this research is the descriptive qualitative method. Qualitative descriptive research aims to describe the phenomena found (Sukmadinata, 2011). The steps used in this research follow the design of Supriatno (2013), which is based on Analysis, Create, Try, and Reconstruct (ANBUCOR). Analysis of the Design of Field Activities (DKL) to be designed includes analysis of field surveys and relevance to the curriculum. The study results are used to create DKL, which refers to the knowledge construction instrument using the Novak-Gowin Vee Diagram rubric (Novak & Gowin, 1984). The DKL is then tested to evaluate its applicability in the field. The findings of the trial results were used as the basis for making improvements and reconstructing DKL to optimize the quality of DKL by fixing the problems that existed in the previous DKL.

RESULTS AND DISCUSSION

Implementing learning with the *field trip* method requires a *field* activity design (DKL) to make activities more directed and obtain the necessary data. Before drafting the design of field activities, it is required to first survey the ecosystem under the objectives of the activities to be carried out by students. DKL is designed according to the survey of observation locations and its relevance to the curriculum. DKL was also analyzed using a Vee Diagram developed by Novak and Gowin in 1984. Then, DKL was tested in locations that had been surveyed previously. The findings and results of the DKL trial became the basis for DKL reconstruction. The following are the stages of designing DKL based on the ANBUCOR (Analyze, Create, Test, Reconstruct) approach developed by Supriatno (2013), as shown in Figure 1.

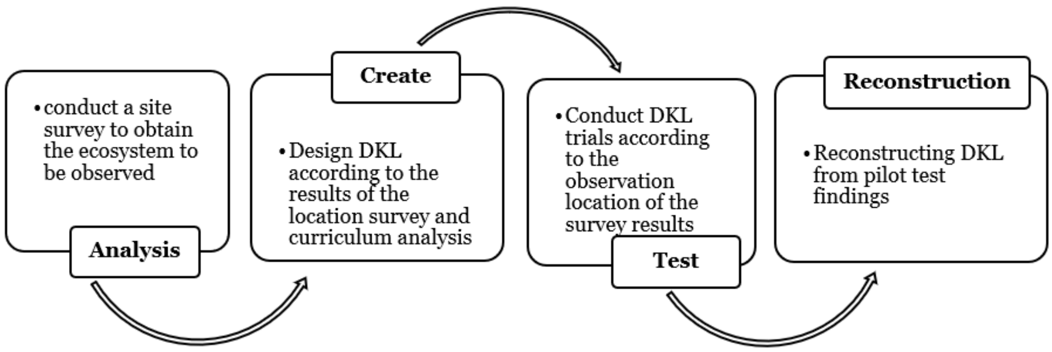

Figure 1. Flowchart of DKL design vased on ANBUCOR

1. Field Survey Analysis

Ecosystems found in nature can be a source of learning for students. Science process skills such as conducting experiments, scientific methods, and student inquiry can be improved by utilizing the environment as a natural laboratory and student learning resource (Anjarwati, 2019). Learning done directly with nature can provide meaningful learning experiences for students. This follows the characteristics of biological material that studies living things and their interactions with the environment. Direct observation activities in nature with the *field trip* method can provide authentic learning experiences to students because it allows them to practice what they learn through other learning methods (Ezechi & Grace, 2018).

Field surveys were conducted in the diverse forest ecosystem of Ranca Upas, Ciwidey, located in Bandung Regency. The selection of the heterogeneous forest location was adjusted to the observation objectives, which were to determine the effect of abiotic factors such as light intensity and soil moisture on the morphological structure of plants in heterogeneous forests. The heterogeneous forest surveyed is very representative to be used as a learning resource because the coverage and observation area is extensive. In addition, our field survey analysis is also based on the ease of access to the observation location and the potential biotic and abiotic factors that can be observed.

2. Curriculum Relevance Analysis

For the design of field activities (DKL) made in the form of Learner Worksheets (LKPD) to be used by students, the DKL design must be relevant to the demands of the curriculum described in the Learning Outcomes (CP) in the Merdeka Curriculum and Basic Competencies (KD) in the 2013 Curriculum. The analysis of the relevance of DKL to the curriculum includes two aspects: the relevance of *competence in activities to the demands of KD / CP* and the *relevance of content in activities to the demands of KD / CP*. The observation activities that will be carried out are related to the material of Biodiversity and Interactions between Ecosystem Components. The material is contained in Phase E, grade 10, in the Merdeka and 2013 Curriculum. The following results of the analysis of the relevance of the curriculum to the DKL to be designed can be seen in Table 1.

Table 1 shows that the relevance of competencies to be achieved through field activities in the DKL design with KD / CP demands has met the minimum curriculum standards. This can be seen in the competency demanded in the 2013 curriculum KD is to analyze which is following the objectives of the field activities to be achieved. The independent curriculum's science process skills element requires students to make observations, question and predict, plan and conduct investigations, and process and analyze data and information. Training these skills for students, of course, can be done with practicum activities in nature.

According to Gürses, Çetinkaya, Doğar, & Şahin (2015) stated that science process skills (KPS) are basic skills that facilitate learning in science, develop a sense of responsibility, improve learning and research methods. In the first indicator, namely observing contained in the DKL design, students are required to be able to observe or observe the morphological structure of various plants in heterogeneous forests. In addition, students must be able to measure abiotic conditions such as light intensity and soil moisture using sensor tools.

Table 1. Results of curriculum relevance analysis with DKL design

Field Activity Objectives	Curriculum 2013	Independent Curriculum
To analyze the effect of Light intensity and soil moisture on the morphological structure of plants in heterogeneous forests.	***Basic Competencies:*** 3.2 Analyze Indonesia's various levels of **biodiversity** and their threats and conservation. 4.2 Analyze Indonesia's various levels of biodiversity and their threats and conservation. 3.9 Analyze the components of the **ecosystem and the interactions between** these **components**. 4.10 Present a work that shows the interaction between ecosystem components (food webs, Biogeochemical cycles).	***Knowledge Elements:*** At the end of phase E, learners can solve problems based on local, national, or global issues related to understanding the **diversity of living things** and their roles, **ecosystem components, and interactions between components** and environmental change. ***Elements of Process Skills:*** 1. Observing 2. Questioning and predicting 3. Plan and conduct an investigation 4. Process analyze data and information

In the second KPS indicator, questioning and prediction, students must question what they want to do in the field practicum activities and what they want to get and understand. Then, students' prior knowledge is used to predict the answers to the practicum activities. Previous knowledge is a combination of knowledge and skills that will create an intense experience to sort out new knowledge that will be received (Panggabean & Tamba, 2020).

The third KPS indicator is planning and conducting investigations. In the DKL design to be developed, work procedures have been designed as operational as possible so that they are easy for students to understand and do and pay attention to work safety because observation activities are carried out in nature. The last indicator is processing and analyzing data and information. In field observation activities, students must be able to record data from observations. Then, the data that has been recorded is transformed into tabular form to help construct new knowledge from the prior knowledge that students have. This follows the opinion of Novak & Gowin (1984) that data recording and transformation can determine the extent to which students can combine the theories, principles, and concepts they have with the records of the observations they get.

The results of the content relevance analysis on the activities in the DKL design show that it is relevant to the essential concepts and other concepts that support field practicum activities. The critical concept that students will understand through observation activities is the interaction between biotic and abiotic factors in heterogeneous forest ecosystems. Students are expected to be able to analyze how the influence of light intensity and soil moisture as an example of abiotic factors on plant morphology as a biotic factor in heterogeneous forests. When there are differences in abiotic factors between one location and another, differences in morphological structures, such as the shape of leaves, roots, stems, and other parts can be observed. The differences in morphological structures in plants cause plant diversity in heterogeneous forests. Based on the analysis of competency relevance and content relevance in the DKL design with curriculum demands, DKL can be implemented and tested.

3. Making DKL based on Vee Diagram (Novak and Gowin, 1984)

Based on the results of the field survey analysis and relevance to the curriculum, the DKL that has been designed can be developed and made to be tested in the field. The developed DKL aims to analyze the influence of abiotic factors, such as light intensity and soil moisture, on the morphological structure of plants in heterogeneous forests. The DKL refers to the knowledge construction instrument developed by Novak & Gowin (1984) using the Vee Diagram rubric. Vee diagram is a heuristic tool to help students understand the structure and meaning of knowledge and laboratory experience (Novak & Gowin, 1984).

The Vee Diagram involves the knowledge dimension on the left and the experience or activity dimension on the right. Both sides interact with each other to gain knowledge during practicum activities. Vee diagram is an instructional strategy involving a *focus question, object* or phenomenon (*event), concept,* principle, theory, *record or transformation,* and knowledge *claim* (Supriatno, 2013). Based on the vee diagram, students are required to be able to find what objects and phenomena to observe, what prior knowledge they already have related to the object or phenomenon being measured and monitored, and then what kind of notes should be made according to the observations obtained. The results of the Vee Diagram analysis of the DKL to be made can be seen in Figure 2.

The main aspect of developing DKL is determining the objects and phenomena that students will discover. In the DKL that will be made, the objects and phenomena expected to appear are various kinds of plants in heterogeneous forests with different morphological structures influenced by abiotic factors such as light intensity and soil moisture. In the first step, students were asked to determine five quadrants with various environmental conditions (light and shade). Then, in each quadrant, light intensity and soil moisture were measured using a *lux meter* and soil *tester*. After that, students are asked to observe the morphological structure of plants found in each quadrant, starting from the root, stem, and leaf organs and comparing them with the characters determined in the DKL. Students' initial knowledge about the morphological structure of plants is expected to help them find objects and phenomena to be observed. So that students can find out whether the factors of light intensity and soil moisture can affect the morphological structure of plants in heterogeneous forests. This aligns with the opinion of Abraham & Millar (2008), who state that practicum activities can help students link objects and phenomena observed with ideas or ideas.

In the next aspect, focus questions that can focus students on objects and phenomena are expected to appear in practicum activities and help students collect data and construct their knowledge. The existence of questions before starting practicum activities can encourage student interest in conducting discussion and investigation activities and as a reflection on whether the investigation activities have answered the problem and produced a new understanding (Münkel-Jiménez et al., 2020). The DKL developed has a focus question in the DKL title section: *"How does the Effect of Light Intensity and Soil Moisture on the Morphological Structure of Plants in Heterogeneous Forests?"*. Through this focus question, students are expected to focus on measuring light intensity and soil moisture in each quadrant and observing the morphological structure of plants around the quadrant based on the characters specified in the DKL. Therefore, Millar (2004) states that focus questions must be stated clearly and accurately so that practicum activities can occur according to the activity's objectives.

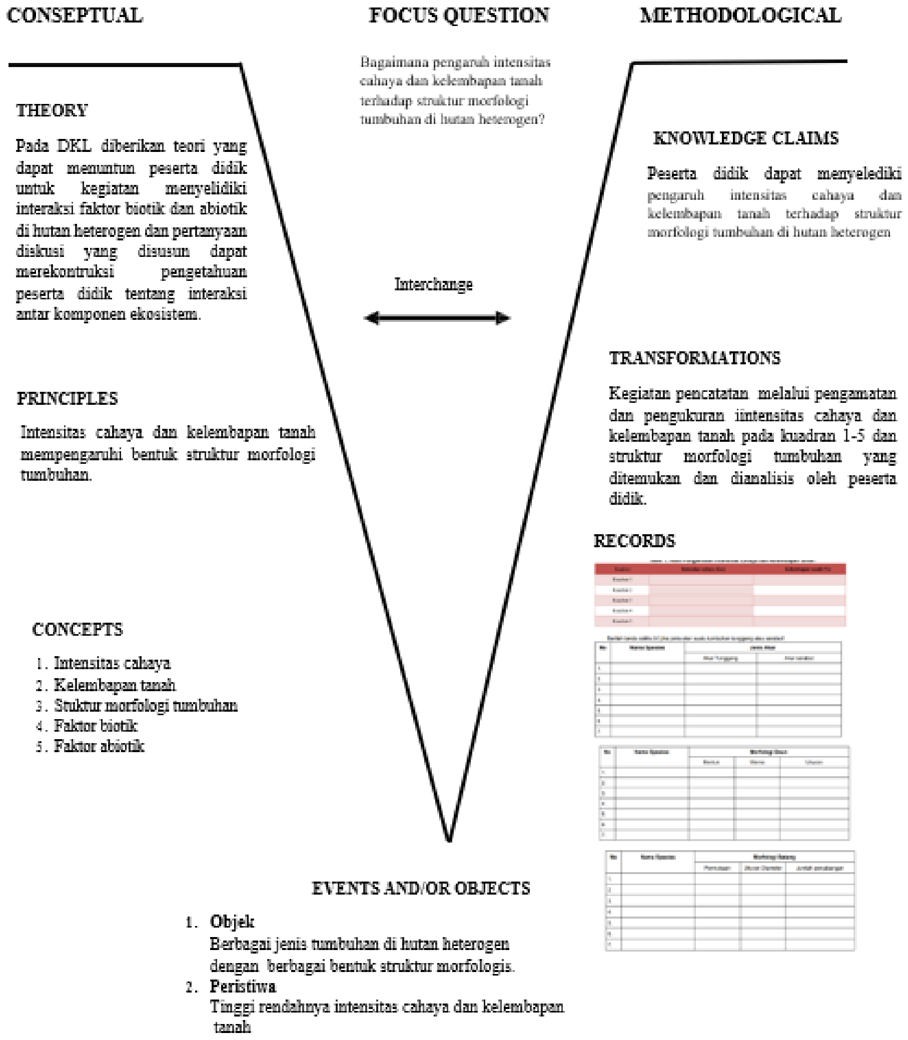

Figure 2. Vee diagram of DKL design of interaction of biotic & abiotic factors of heterogeneous forest

The next aspect is the theory/principle/concept relevant to the object or phenomenon. The concepts that arise in this observation activity are light intensity, soil moisture, and plant morphological structure. The activities carried out by students according to the DKL design are measuring light intensity and soil moisture using sensor tools and observing the morphological structure of plants found in the exact location. Different morphological structures in the same species will be created in locations with high light intensity or low light intensity until students can finally conclude the effect of light intensity and soil moisture on the morphological structure of plants in heterogeneous forests. Novak & Gowin (1984) state that theories, principles, and concepts are essential components as a foundation that can support understanding and direct students in organizing observational data for the data collected to support a knowledge claim.

The aspect of data recording and data transformation aims to guide students in recording the results of observations in a form that is easier to understand, such as tables or graphs, so that it can help find answers to the focus questions that have been made. In the DKL developed, students must fill in four tables to record observation data, including one table to record the results of measuring abiotic factors and three tables to record the observations of plant morphological structures, as seen in Figure 2. If the process of recording and transforming data in practicum does not occur, then knowledge claims can be wrong or irrelevant to concepts, principles, and theories (Wahidah et al., 2018).

In the knowledge claim aspect, learners are expected to apply the concepts, theories, and principles they already have from their prior knowledge to construct new knowledge. Leading questions in DKL must be structured in such a way as to enhance and change the meaning of previously known concepts and principles and find new relationships between them. A DKL must be designed to help students construct knowledge and develop thinking skills to make practicum activities more meaningful (Siregar et al., 2022). The knowledge claimed to be achieved from this field practicum activity is the influence of light intensity and soil moisture on the morphological structure of plants in heterogeneous forests. The knowledge claim process can be directed by using leading questions arranged systematically, from questions that ask data about objects/phenomena that appear to be conceptual questions to questions that ultimately ask students to make conclusions. The leading questions on the DKL include: how is the light intensity condition in each quadrant? What is the soil moisture condition in each quadrant? How is the morphology of plants in heterogeneous forests based on observations? Does light intensity affect plant morphology in heterogeneous forests? Does soil moisture affect plant morphology in heterogeneous forests?; make conclusions from the observations you make!. After completing the design and creation based on the Vee Diagram analysis, the DKL was tested in the ecosystem that had been surveyed previously.

4. Trial Results

Based on the results of the trials that have been carried out, several problems can be found. Then, these problems will be reconstructed to make them better and more relevant to students in obtaining knowledge from observing data in the field.

Table 2. Description of problems in the field activity design trial

No	Aspects	Problems
1.	Determination and creation of data capture quadrants	There is no explanation of the distance between quadrants in the image, making it confusing during data collection.
2.	Variables that act as limiting factors for observation	No limiting factors were determined to determine the morphological characteristics of plants in dark and light places.
3.	Data acquisition is not yet representative of the tree habitus	There is no representation of the tree habitus, namely shrubs, shrubs, and trees.
4.	Quantification of data processing	No data processing shows the effect of solar intensity on soil moisture.
5.	Number of plant samples included in the data	There is no information in the work step on how many samples are identified primarily in the same species.
6.	Books or media used to help identify the morphology of plant parts	The tools and materials section has no guidebook for identifying root, stem, or leaf morphology.

Data collection must be clear and representative in determining and making quadrants so that students can collect data appropriately. Vegetation is a collection of several plant species living in one place and closely interacting with components (Hidayat et al., 2017). The transect line method can determine how vegetation is in an ecosystem. The line transect method can be used to quickly determine the relationship between changes in vegetation and the environment and the relationship between vegetation on land (Sari, 2018). Lines with lengths ranging from 50-100m are usually used in forests. Line transects aim to determine the effect of vegetation changes and environmental changes. In this DKL, the variables that become limiting factors are light intensity and soil moisture because the characteristics of trees in heterogeneous forests have wide canopies that can affect the microclimate under the canopy.

At the time of the DKL trial, no limiting factor was determined on shady and bright places. Shady conditions mean that the place is covered by plant canopy so that the intensity of sunlight entering is relatively small, while in bright conditions, the location of the quadrant tends to have no canopy cover so that the intensity of light entering is relatively higher. Consequently, researchers incorporated the PlantNet application to identify plant morphology and parts. Regarding tree habitus representation, the DKL has not determined whether to take data samples to fulfill the representation of each habitus consisting of shrubs, herbs, shrubs, and trees. The observation results show that most species have a shrub habitus. Thus, some plant parts' characteristics and distribution are still not representative.

Table 3. Observation of stem morphology

No	Species's name	Stem morphology		
		Surface	**Diameter size**	**Number of branches**
1.	*Viola adonata*	Covered with moss	1 cm	No branching
2.	*Pellioria radians*	Not covered with moss or fern	1 cm	2 branches
3.	*Solanum pseudocapsicum*	Not covered with moss or fern	1.4 cm	No branching
4.	*Thelypteris denata*	Not covered with moss or fern	1 cm	No branching
5.	*Casearia decandra*	Not covered with moss or fern	30 cm	Simpodial
6.	*Anoectochilus brevilabris*	Not covered with moss or fern	3 cm	No branching
7.	*Strobilanthes flexicaulis*	Not covered with moss or fern	0.3 cm	No branching

Figure 3. Observation of *Anoectochilus brevila\bris* plants in heterogeneous forest

Figure 4. Observation of *Casearia decandra* plants in heterogeneous forest

Figure 4 shows the student can examining the leaves (*Casearia decandra)* of a plant growing on a tree in a forest environment to identify plant morphology and parts. The light observation and soil moisture in different quadrant result represented in Table 4.

Table 4. Observation of light intensity and soil moisture

Quadrant	Light Intensity (Lux)	Soil Humidity (%)
1st quadrant	226	60
2nd quadrant	160	62
3rd quadrant	291	60

5. DKL Reconstruction Result

Based on the Ranca Upas heterogeneous forest survey analysis results, LKPD was developed based on curriculum relevance and knowledge construction. The developed Field Activity Design (DKL) analyzes the diversity of vegetation and heterogeneous forest ecosystems. The results of the analysis of findings and constraints are presented after testing the DKL to create an alternative DKL for practicum identification of vegetation and heterogeneous forest ecosystems. The purpose of DKL reconstruction is to optimize effectiveness because, based on the results of the experiment, the effectiveness of the DKL is still in the category. DKL reconstruction is focused on tools, procedures, and questions. Based on the results of the trial, there were several obstacles in the implementation of the practicum. There is currently no guide to identifying the morphology of roots, stems, and leaves, which makes it challenging for students to identify plant species. Therefore, researchers added the use of the *PlantNet* application to determine morphology and plant parts. The *PlantNet* application is helpful for identifying plants based on photos (Sulfayani *et al.,* 2023). *PlantNet* application is a plant identification media that can improve student learning outcomes to impact the completeness of learning outcomes positively (Mu'minah *et al.,* 2023).

The inhibiting factor in the procedure is that there is no explanation of the distance between quadrants in the picture it confuses researchers in random sampling so it needs to be listed clearly and in detail by writing the quadrant of shrub and herbaceous habitus with a size of 1 x 1 m and the quadrant of tree and shrub habitus with a size of 5 x 5 m. Sampling density mapping is done by placing a 5 x 5 m quadrant to mark that the area will be calculated for accuracy (Suryanti & Purwanti, 2014). The 5 x 5 m plot was used for sapling-level plants. To effectively analyze the distribution of understory and seedling-level plants, utilizing 2 x 2 m or 1 x 1 m plots is essential. This approach allows for precise assessments tailored to the distribution and homogeneity of area coverage

(Kurniasih, 2021). Determining a clear quadrant based on habitus will make it easier for students to collect data because it already represents each habitus so the data obtained is more comprehensive. In the DKL reconstruction, students are directed to make 6 quadrants for each habitus, three for the light and three for the dark.

Another challenge faced in practicum implementation is that no limiting factor is determined to determine the morphological characteristics of plants exposed to light (in bright places) and not exposed to light (dark areas). Hence, a solution must be given by determining the limiting factor for data collection in bright and dark places. The different growth rates are caused by differences in plant age, which can cause differences in plant density and affect the presence of light intensity on plants (Situmorang, 2020). The lower the light intensity, the more leaves are found compared to the open place, which is the high light intensity (Farhaby & Anwar, 2021). In addition to the procedure, the practicum questions were reconstructed by adding questions to quantify data processing. The question asked to draw a graph of the effect of light intensity and humidity. Making graphs based on data can improve students' science process skills because it can transform and improve students' thinking skills. The ability of students to read graphs will increase based on school levels (Nurlaelah *et al,* 2020). Therefore, the thinking ability of high school students increases. Laboratory Activity Design can be seen in detail in Figure 3.

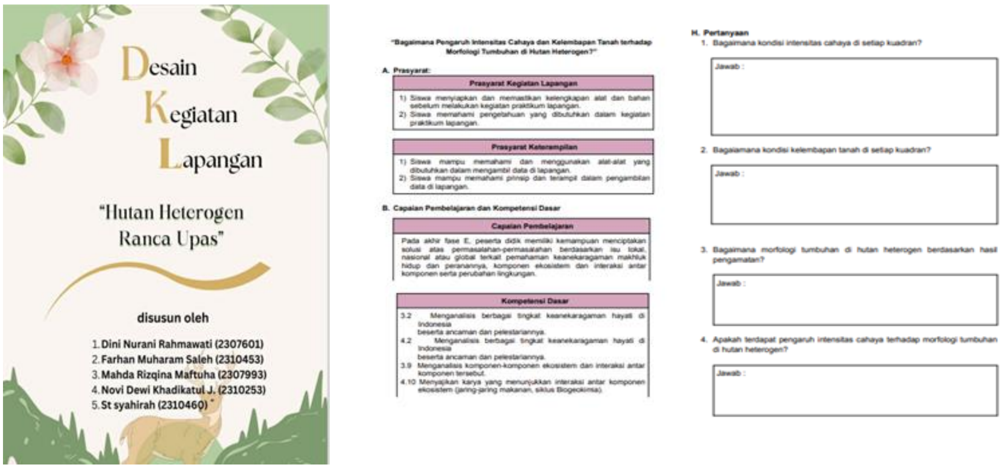

Figure 5. DKL reconstruction result of heterogeneous forest

CONCLUSION

The DKL analysis and testing results on a *field trip* in the heterogeneous forest of Ranca Upas showed several problems, such as determining and making data collection quadrants, representation of tree habitus, data processing, plant samples, and plant morphological identification media. The proposed solutions to the DKL reconstruction include adding the *PlantNet* application, reconstructing the procedure for determining the distance between quadrants, making quadrants based on habitus, and determining the limiting factor for data collection. In addition, practicum questions were reconstructed with questions for quantification of data processing. This reconstruction is expected to increase the effectiveness of *field trips* in improving student learning outcomes and environmental awareness. This study implies that the reconstructed DKL can be a reference for biology teachers when designing more useful *field trip* activities. Further research needs to be conducted to test the effectiveness of the reconstructed DKL and develop DKL in other locations with different characteristics.

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REFERENCES

Akubuilo, A. (2010). A Sense of Place. *Science Teacher*, *78*(15), 12. https://www.studocu.com/row/document/alupe-university-college/educational-planning/influence-of-field-trip-in-teaching-and/46076268

Anjarwati, S. (2019). Pemanfaatan alam terbuka sebagai sumber belajar biologi. *BIOEDUKASI: Jurnal Pendidikan Biologi*, *10*(1), 55-60. http://dx.doi.org/10.24127/bioedukasi.v10i1.2009

Aziz, A., & Shaleh, M. (2019). Variasi metode pembelajaran dan peningkatan motivasi belajar siswa. *Edupedia: Jurnal Studi Pendidikan dan Pedagogi Islam*, *4*(1), 87-94. https://doi.org/10.35316/edupedia.v4i1.529

Bassaw, T. K., Tabil, F. A., & Donkor, S. T. (2022). Teachers' Use of Field Trip to Evaluate Social Studies Lessons in the Senior High Schools in Ghana. Universal Journal of Social Sciences and Humanities, 2(4), 219–233. https://doi.org/10.31586/ujssh.2022.558

Department of Environment. (2019). Get to know the Forest and its Functions. Dlh.Bulelengkab.Go.Id. https://dlh.bulelengkab.go.id/informasi/detail/artikel/kenali-hutan-dan-fungsinya-53

Dewi, K. T. (2021). The Effect of Outdoor Learning in the Form of Environmental Exploration and Motivation on Biology Learning Outcomes of Class X Students of SMA Negeri 1 Gianyar. Wahana Math and Science: Journal of Mathematics, Science, and Learning, 15(1), 110-120. https://doi.org/10.23887/wms.v15i1.31695

Ezechi, N. G. (2018). Influence of field trip in teaching and learning of biology. *International Journal of Engineering & Scientific Research*, *6*(10). https://www.studocu.com/row/document/alupe-university-college/educational-planning/influence-of-field-trip-in-teaching-and/46076268

Farhaby, A., & Anwar, S. (2021). Effect of Light Intensity on Growth and Chlorophyll Content of Kale Plant Leaves (Ipomoea aquatica Forsk.). Journal of Agrotechnology, 9(1), 1-8.

Gürses, A., Çetinkaya, S., Doğar, Ç., & Şahin, E. (2015). Determination of levels of use of basic process skills of high school students. *Procedia Social and Behavioral Sciences, 191*, 644-650. https://doi.org/10.1016/j.sbspro.2015.04.243

Hamid, A. (2019). Berbagai Metode Mengajar bagi Guru dalam Proses Pembelajaran. *Aktualita: Jurnal Penelitian Sosial Keagamaan*, 9(2), 1-16. https://ejournal.an-nadwah.ac.id/index.php/aktualita/article/view/97

Hidayat, M., Laiyanah, L., Silvia, N., Putri, Y. A., & Marhamah, N. (2018). Analisis vegetasi tumbuhan menggunakan metode transek garis (*line transek*) di hutan Seulawah Agam Desa Pulo Kemukiman Lamteuba Kabupaten Aceh Besar. *Prosiding Seminar Nasional Biologi, Teknologi dan Kependidikan, (5)*1. http://dx.doi.org/10.22373/pbio.v5i1.2198

Hill, A. (2013). The place of experience and the experience of place: Intersections between sustainability education and outdoor learning. *Australian Journal of Environmental Education, 29*(1): 18–32. https://doi.org/10.1017/aee.2013.13

Hindayati, I. (2023). Analysis of Field Trip Learning Methods on Students' Learning Outcomes in High School (SMA). *Geography Science Education Journal,* *4*(1), 13-18. https://jurnal.unsil.ac.id/index.php/geosee/article/view/6613

Kisiel, J. F. (2003). Teachers, Museums a Worksheets: A Closer Look at a Learning Experience. *J. Sciences Teacher Education 14*(1):3-21, 2003. https://www.jstor.org/stable/43156305

Kurniasih, S. (2021). *Team Based Project Ecology Practicum Guide for 2021/2022 academic year*. Serang: Sulteng Ageng Tirtayasa University.

Law No. 41. (1999). *Basic Provisions of Forestry*. Jakarta http://www.flevin.com/id/lgso/translations/Laws/Law%20No.%2041%20of%201999%20on%20Forestry.pdf

Lestari, P. P., Anggraeni, S., & Supriatno, B. (2021). Rekonstruksi DKL Materi Pteridophyta: Fenetik sebagai Sebuah Pendekatan:(Reconstruction of Practical Activity Design on Pteridophyta Materials: Phenetics as an Approach). *BIODIK*, *7*(3), 36-45. https://doi.org/10.22437/bio.v7i3.13037

Marini, M., Rahayuningsih, M., & Retnoningsih, A. (2016). Efektivitas metode field trip di sungai kaligarang semarang terhadap hasil belajar siswa materi pengelolaan lingkungan. *Journal of Biology Education*, *5*(1). https://doi.org/10.15294/jbe.v5i1.12472

Millar, R. (2004). The role of practical work in the teaching and learning of science. *Commissioned paper-Committee on High School Science Laboratories: Role and Vision. Washington DC: National Academy of Sciences*, *308*, 1-21. http://www7.nationalacademies.org/bose/Robin_Millar_Final_Paper.pdf

Muchsin, A., Nurfadilah, Z., Riandi, R., & Supriatno, B. (2021). The Effectiveness of Field Trip Method Using PlantNet Applications on Spermatophyte Concepts as an Alternative Learning Innovation. *BIODIK, 7*(3), 20-27. https://doi.org/10.22437/bio.v7i2.13126

Mu'minah, I. H., Rasyid, A., & Sugandi, M. K. (2023). Effectiveness of Field Trip Method Assisted by Plantnet Application as a Media for Plant Identification in the Mandapa Arboretum Forest Area, Majalengka Regency. *BIO EDUCATIO: (The Journal of Science and Biology Education), 8*(1). https://dx.doi.org/10.31949/be.v8i1.4840

Münkel-Jiménez, M., Bonilla-Araya, M., Gray-Pérez, A. D., & Herrera-Sancho, O. A. (2020). Awaking Interest in Science Learning: Hands-On Photosynthesis Demonstrations Using Elodea Canadensis and Spinacia Oleracea. *Journal of Chemical Education, 97*(2), 457-461. Https://Doi.Org/10.1021/Acs.Jchemed.9b00216

Novak, J. D., & Gowin, D. B. (1984). *Learning How to Learn*. Cambridge University Press. https://doi.org/10.1017/CBO9781139173469

Nurhasnah, N., Miarsyah, M., & Rusdi, R. (2019). The effectiveness of field trip in biology learning towards students' increased concern for biodiversity values. *Indonesian Journal of Science and Education, 3*(1), 43-47. https://doi.org/10.31002/ijose.v3i1.860

Nurlaelah, F., Cahyawati, L. E., & Aminah, N. (2020). Improving Graph Reading Ability of Junior High School Students through Contextual Science Learning Based on Jigsaw Type Cooperative Learning Model. *Journal of Science Education, 8*(1), 5-12.

Panggabean, R. F. S. B., & Tamba, K. P. (2020). Difficulty in Learning Mathematics: Prior Knowledge Analysis [Difficulty in Learning Mathematics: Prior Knowledge Analysis]. *Johme: Journal of Holistic Mathematics Education, 4*(1), 17. Https://Doi.Org/10.19166/Johme.V4i1.2091

Purnama, M. M. E., Rammang, N., Mau, A. E., & Sipayung, R. H. (2022). Diversity of Soil Macrofauna in Homogeneous and Heterogeneous Forest Habitats in the Sisimeni Sanam Education and Training Forest Area, Kupang Regency, East Nusa Tenggara. *Journal of Wana Lestari, 4*(2), 453-459 https://doi.org/10.35508/wanalestari.v7i02.9615

Rozaq, M. I., & Kocimaheni, A. A. (2020). Suitability of the Learning Implementation Plan (RPP) with the Implementation of Japanese Language Learning in Class X of Senior High School. *UNESA, 21*(1), 1-9. https://ejournal.unesa.ac.id/index.php/kejepangan-unesa/article/view/31446

Safriandono, A. N., & Charis, M. (2014). Designing E-Student Worksheets as a Practical, Flexible and Educational Web-based Learning Media. *Tatal, 10*(1), 25-35. https://www.neliti.com/id/publications/221635/rancang-bangun-e-lembar-kerja-siswa-sebagai-media-pembelajaran-yang-praktis-flek

Sari, D.N., dkk. (2018). Analysis of Plant Vegetation Using the Transect Method (*Line Transect*) in the Deudap Pulo Aceh Forest Area, Aceh Besar District. *Proceedings of the National Biotic Seminar*. 165-173. http://dx.doi.org/10.22373/pbio.v6i1.4253.g2789

Siregar, N. F., Sholihah, R. N., Supriatno, B., & Anggraeni, S. (2022). Analysis and Reconstruction of Alternative Laboratory Activity Design with Quantitative Literacy Content in Ingenhousz Photosynthesis Practicum. *Basicedu Journal, 6*(4), 7532-7543. https://doi.org/10.31004/basicedu.v6i4.3568

Sukmadinata. (2011). Education Research Methods. Teenage Workshop. https://inlislite.uin-suska.ac.id/opac/detail-opac?id=22622

Sulfayanti, R., Dirhamzah & Nurindah. (2023). Analysis of understory vegetation in Topidi Conservation Forest Area, Tinggimoncong District, Gowa Regency. *FILOGENI Journal of Biology Students, 3*(1). 38-43. https://doi.org/10.24252/filogeni.v3i1.30813

Supriatno, B. (2013). *Development of Ancorb-based School Biology Practicum Development Course Program to Develop the Ability to Design and Develop Laboratory Activity Design*. University of Education Indonesia. https://repository.upi.edu/113136/

Surbakti, A. (2015). The Effect of Field Trip Learning Strategy and Biodiversity Knowledge on the New Environmental Paradigm (NEP). *Journal of Progressive Education*. https://jurnal.fkip.unila.ac.id/index.php/jpp/article/view/14937

Suryanti, F., & Purwanti, D. (2014). Vegetation Structure and Plant Species Diversity in Ijen-Blambangan Crater Protection Forest, East Java. *Journal of Biodiversity, 15*(3), 306-312.

Wahidah, N. S., Supriatno, B., & Kusumastuti, M. N. (2018). Analysis of the Structure and Occurrence of Cognitive Levels in the Design of Laboratory Activities for Photosynthesis Materials. *Indonesian Journal of Biology Education, 1*(2). https://doi.org/10.17509/aijbe.v1i2.13050

Widia, V., Indihadi, D., & Rustono, W. S. (2016). The Effect of the Tourism Method on Student Learning Outcomes about the Economy of the Surrounding Community. *Pedadidaktika: Scientific Journal of Elementary School Teacher Education, 3*(1), 117-128. https://doi.org/10.17509/pedadidaktika.v3i1.5099

Widodo, H., Sari, D. P., Wanhar, F. A., & Julianto, J. (2021). Pengaruh Pemberian Layanan Bimbingan dan Konseling Terhadap Komunikasi Interpersonal Siswa SMK. *Edukatif: Jurnal Ilmu Pendidikan*, *3*(4), 2168-2175. https://doi.org/10.31004/edukatif.v3i3.1028

Wiryono. 2020. *Forest Ecology and its Applications*. UNIB Press.