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Research paper

Field Activity Management Learning Cycle 5-E Model in Linow Lake

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Abstract

Linow Lake is located in Tomohon City, North Sulawesi Province is an interesting geothermal area with a rich ecosystem of Physics study objects. Linow Lake has been utilized as an object of physics and physics education study of Physics Department Faculty Of Mathematics And Natural Sciences Manado State University, but there is no systematic design and has not been done regularly as part of the lecture. This research gradually designs and implements the management of field activities of learning cycle 5-e model in integrated Linow lake with lectures. Research method using research and development design. The stages of materials and field activities developed adopt the 5E learning cycle (E1: engagement, E4: elaboration, E5: evaluation) as a benchmark for competence development, associated with the field activities stage (K1: introduction and attraction of the object study, K2: exploration of study objects and building skills: practicum, K3: deepening and elaborating knowledge and skills through independent research (or collaboration), and K4: comparative research, applied and competency evaluation for independent activity development The results show that management activities the field of learning cycle 5-e model can support the physics lecturing process that gives systemic direction to the students to carry out field activities and development of independent activities so as to build the comprehensive graduate student competence.

Keywords: *Field activities, Indonesia; learning cycle 5-E; Linow Lake; Management.*

1. Introduction

1.1. Background Research

Higher quality education always applies flexible and dynamic management principles to enable each university to grow in accordance with its own potential and external demands it faces. Management is often defined as science, tips / art, and profession. Shrode Dan Voich [1974], which [1] dictated that the primary goal of management is productivity and satisfaction. This goal is not single or multiple, such as improving the quality of education. Furthermore, [1] mentions that managerial activities cover many aspects, but the main and essential aspects of planning, organizing, actuating, and controlling. George R. Terry and Stephen G. Franklin in their book "Principles of Management" also emphasize four different parts of the management process, shortened by the words POAC: planning, organizing, actuating, and controlling [2].

Every organization always needs management because without effective management there will not be a successful effort long enough. Management will give effectiveness to human effort [3]. The world of education also can not be separated from this management system. In education there are some fundamental weaknesses in the implementation of education in Indonesia, and the fundamental weaknesses, among others, the field of management that includes the dimensions of process and substance. At the level of the process, such as planning, implementation, and evaluation have not been done with strict working procedures. At the substantive level, such as personnel, finance, facilities and infrastructure, learning instruments, auxiliary services, library services, etc., not only the substance is not comprehensive, but success criteria for each has not been determined consistently [4] Management is required for all types of organized activities including for field activities in lectures at universities. In practice, management is needed wherever people work together (organization) to achieve a common goal.

[5] points out the importance of field activities for students performing observation, experimentation and testing activities. Observation activities, field measurements can improve students' comprehension of the objects studied while building the mastery of procedures and the process of studying objects in nature. The experimental procedure using research steps is the most effective method of learning and learning methods to build student mastery over innovations [6]. The principles of constructivism in the development of authentic learning activities through experiments in the lab and in the field [5] are: 1) building art or experimenting pleasure, 2) constructing experimental skills and conducting analysis, 3) studying concepts : the lab helps students to master basic concepts of physics, 4) Understand the basics of knowledge in physics such as how to perform direct observation, recognize the process of building knowledge based on theory or experiment, 5) develop collaborative learning skills.

Manado State University is one of the universities in Indonesia which has a physics department under the Faculty of Mathematics and Natural Sciences and has two courses namely Physics Education Program and Physics Study Program. Physics Department in the odd semester of the academic year 2016/2017 has the number of students 727 students with the number of lecturers 26 people. The results of observations of researchers on the implementation of lectures in the department of Physics, showed that lectures are dominated by the transformation of knowledge unilaterally, by

lecturers to students so that students become passive and less creative participants. Lecturers in lectures, generally do not provide sufficient directives about competence, lecture scenarios, facilities and utilization. Not many lecturers prepare special time for consultancy services for students. The function of lecturers as an academic supervisor is not optimal either to control student academic activities, or to motivate students to develop competence. In part, lecturers in the lectures are less focused on the formation of graduate competencies. In terms of assignment, lecturers do not give strengthening knowledge, attitudes and skills for students because the task given is not continuous and disengaged, nor contextual. Implementation of field activities have not been designed to the fullest and follow the steps according to level (semester). Lecturers rarely provide feedback as a reflection of lectures. Students are positioned as lecturers listening lecturers, without being given the opportunity to participate democratically in the lecture. Students lack the initiative and are not creative in doing the task, including getting and formulating thesis research idea. Students' learning achievement is low and the study period exceeds four years. Students are weak in the mastery of physics concept relationships with context. One of the causes of this is related to the lack of field activities designed as part of the lecture program. This lecture problem requires comprehensive improvement, focusing on improving motivation, learning initiatives through independent activities, strengthening field experience, developing the ability to formulate research ideas all of which leads to management problems for the system to run to achieve the expected goals.The result of observation of lecturing process also shows that the implementation of Field Activity in the Department of Physics is still the work of tourism has not been designed coherently and tiered and not yet integrated with the lectures so as not to systemically build student competence or it can be said that field activities in the Department of Physics FMIPA UNIMA not optimal in generating graduates who have competence in the field of Physics. One of the root causes of the field management system activities physics majors have not run well. Result of inventory object of field study of Physics Department showed that Lake Linow area Tomohon City is an interesting area and rich in physical field study object. In the area of Lake Linow Lahendong power plant, and presents a variety of physical phenomena that can be subjected to studies related to the concepts of science in the field of mechanics, thermodynamics, electricity and so on. Variations of physical phenomena in the lake area: Linow is very rich for the development of various field activities such as observation, measurement, experimentation, research, research-based practicum etc. Utilization of Linow lake area for field activities for students majoring in physics will provide reinforcement of materials obtained in lectures theory and lab work in the laboratory. Fieldwork presents a rill phenomenon that is sometimes difficult to control like in a laboratory room.

1.2. Research Purposes

1. To design the management of field activities at Lake Linow for students majoring in Physics FMIPA UNIMA.
2. To implement the management of field activities at Lake Linow for students of Physics Department FMIPA UNIMA.

2. Literature Review

2.1. Definition and Function Management

George Terry defines management in his Principles of Management, "A process that distinguishes the planning, organizing, mobilization and supervision by utilizing both the science and the art of demmi achieve predetermined goals". From Terry's definition that we can see the management function according to him. Here is a management function by Terry [2]
a. Planning (planning) is as a rationale of the objectives and preparation of steps that will be used to achieve goals. Planning means preparing for all needs, taking into account whatever the constraints, and formulate the form of implementation of activities that maximize to achieve goals.
b. Organizing (organization) is as a way to collect people and put them according to ability and expertise in work that has been planned.
c. Movement (actuating) is to move the organization to run in accordance with the division of labor and mobilize all existing resources in the organization for work or activities undertaken to run as planned and can achieve goals.
d. Supervision (controlling) is to monitor whether the movement of this organization is in accordance with the plan or not. And oversee the use of resources in the organization to be used effectively and efficiently without any deviation from the plan

2.2. Learning Cycle Learning Models-5-E

Learning Lifecycle Learning Model 5E (Engagement, Exploration, Explanation, Elaboration, Evaluate) is a learning model consisting of phases or stages of activities organized in such a way that learners can master the competencies that must be achieved in learning by playing an active role. This model is one of the learning models that match the paradigm of constructivism. The constructivist theory approach basically emphasizes the importance of learners building their own knowledge through the involvement of the teaching and learning process. So that the learning process is more student-centered.

2.3. Steps of Learning Model 5E

According to [7], The steps in the 5E learning cycle model are as follows:
1. Engagement (Preparation). In this phase the teacher assesses the prior knowledge of students and help them to be interested in new concepts through the use of short activities to trigger curiosity. Activities undertaken should link the previous learning experience with the learning experience to be undertaken, expose the student's initial conception, and organize the students' thinking to achieve the objectives of the learning to be performed.
2. Exploration. In the exploration phase students have the opportunity to engage in activities where the concepts they already possess, misconceptions, learning processes and skills are identified and changes in conception are facilitated. Students can complete laboratory activities that will help them use initial knowledge to generate new ideas, explore questions and possibilities, and design and conduct investigations.
3. Explanation. Focuses students' attention on a particular aspect of their learning experience in the engagement and exploration phases and provides an opportunity to demonstrate understanding of the concepts, skills of the process of science, or certain behaviors. This phase also provides an opportunity for teachers to directly convey concepts, processes, or skills. Students explain their understanding of concepts. Explanations from teachers can lead them to a deeper understanding, which is the most important part of this phase.
4. Elaboration. In the elaboration phase (teacher elaboration) challenges and broadens students' conceptual understanding and skills. Through new learning experiences students develop a deeper and broader understanding, gaining information, and skills. Students apply their understanding of specific concepts by performing additional activities.
5. Evaluation. In the last phase of the 5E learning cycle model, the evaluation phase, students try to assess their understanding and ability. In addition to this phase, teachers also have the opportunity to evaluate student progress in achieving the learning objectives that have been set

3. Methodology

This research uses design or research and development (R & D model) model, research development model according to formulated by Akker (2006). This design is circular from analysis activities, designing, evaluating, and revising to the desired destination. This research development model is schematically presented in Figure 1.

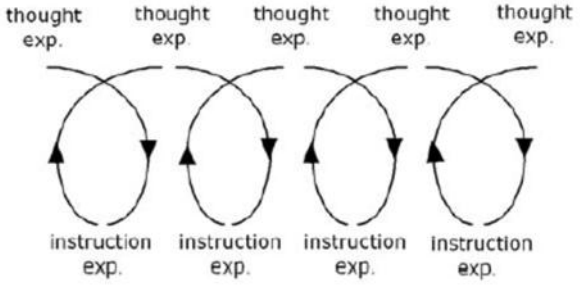

Fig. 1: Research development, a cyclical process

The design of this development research is based on the principle of development of field activity model that is to build a democratic learning climate that accommodate various variations of student condition as subject and field condition (learning object). The design of this development research is open to the development of materials and activities, related to the development of science and technology, and products of learning and research activities at Lake Linow. This mechanism is complementary and improves the quality of the design, along with increasing efficiency, productivity and relevance of student competence formation.
Research subjects are students of Department of Physics FMIPA UNIMA with research location in UNIMA campus and Lake Linow area

3.1. Data Collection Technique

The design and implementation data collection using check list to evaluate the development of the completeness of the design, the suitability of the implementation with the design (according to the stage) that is cyclic (following the lecture). Data collection of student learning activities using observation format with 5-E indicators in the focus of field activities. Student learning process data is explored through interviews to obtain student patterns and trends as revised draft feedback (following an open cyclic development mechanism and qualitative approach). Efficiency and learning productivity are evaluated by time of task, completeness of task to target in every design stage. The data is presented quantitatively, along with the description of student's search results in following the program and field activities. The data of policy, curriculum, organizational structure, lecturer competence, enrollment quality etc., obtained through examination of documents, consultation with the manager of Prodi Science Physics and lecturer team

3.2. Data Analysis Technique

Data analysis includes quantitative and qualitative analysis. Based on the scheme for the development of field activities, the study was designed to follow qualitative research mechanisms given benchmark (conceptual scheme) ie coherence tiered achievement of competence with 5-E approach. Quantitative analysis (description of percentage, average, variance, and correlation etc.) is used for learning process indicators (5-E) and other measurements in each stage or activity level. Qualitative analysis is also used to track individual condition information that indicates significant deviations from the general trend of students as indicated by quantitative data. This search is important to get information about individual learning patterns etc. as inputs in the development of the design of field activities and related lectures.

4. Results and Findings

4.1. Planning for Field Activities

The nature of the management function according to George Terry is what he plans to achieve. The planning stages as follows:

4.1.1. Formulation of Objectives

Formulation of objectives of field activities agreed through the department meeting together with the direction of majors and all lecturers in the physics department. The results of the formulation of field objectives for the physics majors are:

1. Produce data to describe the general phenomenon of nature, the factors that control and influence it. Data and information on research results are needed, among others, for resource management, conservation activities, security / safety or disaster mitigation.

2. Produce data changes of physics variables, interaction between physical variables, special conditions that become limiting factors of change (spatial, temporal, combined) physics variable. This data and information should be detailed for more specific utilization purposes and for scientific development (research methods and innovative outcomes). Measurement of physics variables is very important and almost always required in field study activities in other fields, because field research in the field of physics can provide information on changes in energy and other quantities that affect natural phenomena and resource utilization

4.1.2. Field Observation

Places for field activities were previously observed and in this study the location of field activities is Lake Linow which is a volcanic lake and diarrhea lake kinow there are manifestations of geothermal which shows that the geothermal system in the area is still active. The appearance of geothermal phenomena which is a good natural phenomenon to be studied to find concepts related to physics so that Lake Linow and surrounding Area is very good for use as a natural laboratory for physics learning.

4.1.3. Activity the Initial Observation is

1. Determination of zoning maps for field activities

The geothermal area of Linow Lake covers Linow lake area, surrounding land comprising of open land / forest, forest, plantation area, and settlement. Within this area there are various manifestations:

a. Hot water pool, in this case is Linow lake. In Linow lake there are several large-scale hot springs and many small hot springs located on the shore of the lake. The water supply of the lake aside from the hot springs, also through the incoming stream from the north.

b.The steamy soil is mostly found in the area around the lake to the residential area (Lahendong village, which lies to the east of Linow Lake) The ecological conditions surrounding the steamy ground manifestations vary, there is a limestone surface, some overgrown and some are overgrown with trees.

c.The mud volcano column, located north of Linow lake geothermal area map is presented in Figure-2. Lake Linow is famous for its color changing lakes, from morning to afternoon. it is related to the solar elevation associated with the reflection of radiation by lake water containing sulfur and other chemicals that vary (spatial) is quite high

Fig 2. Linow lake geothermal area map

Result of identification of geothermal manifestation of geothermal area of lake of Linow, yield six zone as shown in figure 2
The western part of the lake (A) The manifestation of hot water, with sufficiently high temperatures, varies between 50^{o}C - 70^{o}C, by area: a radius of about 20 m
The northern part of the lake (B) Water with low temperature, 22 ^{o}C - 28^{o}C, fluctuating due to the sun penyi naran, there are marine biota and become the habitat of ungas
Eastern lake (C) Manifestations of hot, small-scale water, on shallow edges of the lake, with temperatures varying between 30^{o}C - 70^{o}C, with an area of radius of about 1m
Steaming gound to the north of the lake (D) Manifestation of steaming gound with center radius of 5 m manifestation, is a limestone without land cove
Land to the south of the lake (E) Manifestation of steaming gound with high spatial variations in soil temperatures characterized by shrubs and small trees
land overgrown with trees in the south of the lake (F) Lands of trees with a microclimate of trees influenced by the thermal manifestations of the lake and surrounding land

2. To examine the characteristics of geothermal manifestations of Linow Lake Area

There are several geothermal manifestations which are the locations of the fumarole steam, steam vent and solfatara fumes, mud pools, and hot springs with a total of eight geothermal manifestation points. The first location there is a type of manifestation of steam vent and solfatara while for the second location is the mud pool, and hot springs. The existence of conduction and convection processes of geothermal fluid generates several types of geothermal manifestations in this area such as the output of steam, hot springs, steamy soil and mud ponds. Lake Linow is a crater that still has volcanic activity beneath it as the caldera of the eruption of the mountain in ancient times so that the source of the warm earth comes from the activity. The geologic structure formed is suspected to arise from volcanic activity since the area is located in volcanoes such as Lokon Mountain.

Table 1: Characteristic of geothermal manifestation in linow lake

Geothermal Manifestation	Coordinat (UTM)		Elevasi (mdpl)	Temperature (°C)		Diameter (cm)	Noise / Quite	pH
	X	Y		Manifestation	Air			
Hot spring	0703508	0140998	789	100	25.3	250	-	2
Mudpool-1	0703358	0140997	787	84.4	25.3	54	-	3-4
Mudpool-2	0703358	0140997	787	92.1	25.3	40	-	3-4
Mudpool-3	0703467	0141007	788	72.3	25.3	124	-	3
Solfatara-1	0702731	0140353	821	100	32.2	9	noise	-
Solfatara-2	0702725	0140344	815	100	32.2	42	noise	-
Steam vent	0702730	0140356	821	100	32.2	64	noise	-

3. Design of field actifities

The 5-E learning cycle (Engangement, Exploration, Elaboration, Explanation, Evaluation is the cycle of a learning process or activity) In this research, the lecture cycle process is adopted to become the reference of field activities, starting from the first semester to the final semester or for thesis research, and thesis This adoption is used as a benchmark for the development of lectures with tasks or field activities on the geothermal manifestation of Linow Lake.This adoption can also be used as a reference to measure the task completeness, satisfaction and motivation of students doing the tasks, and feedback to analyze and improve the design of field activities. The result of identification of 5 E field cycles for students majoring in Physics, Geothermal Concentration is presented in Table.1

Table 2:. Formulation of adoption of the 5-E learning cycle in the design of field activities at six locations in Linow lake

No	zona	The 5-E learning cycle is a benchmark for achieving field activities
1	A. The western part of the lake	E-1, E-2, E-3, E-4, dan E-5
2	B. The northern part of the lake	E-1, E-2, E-3, E-4, dan E-5
3	C.The eastern part of the lake	E-1, E-2, E-3, E-4, dan E-5
4	D.Steaming gound north side	E-1, E-2, E-3, dan E-4
5	E.Land to the south of the lake	E-1, E-2, E-3, E-4, dan E-5
6	F.land overgrown trees (south lake)	E-1, E-2, E-3, E-4, dan E-5

E-1: Engangement (tourism activity, initial introduction, survey (field activities of students semester I, II
E-2: Exploration (surface survey activity, measurement of surface physical properties of manifestation (field activities of students in second semester, III)
E-3 Elaboration (practicum: observation of physical properties, causality analysis, reporting, phenomenon relationship with concepts) (field activities of semester students (II, III, IV)
E-4. Explanation (research, analysis and data modeling, explanation of the impact of geothermal manifestation on the environment, potential pneumatic and spatial variations and heat loss and factor calculation (field activities of fourth semester students, V, VI and / or thesis research)
E-5 Evaluation: Comprehensive description of phenomena around manifestation, interaction of physical, chemical and biological properties, prediction of manifestation and environmental conditions (field activities of fourth semester students, V, VI and / or thesis research).

4.2. Organizing

Organizing activities include the components and roles presented in Figure 3

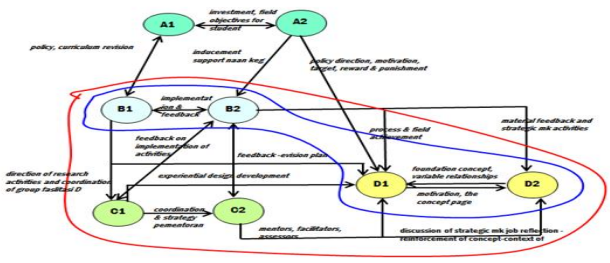

Figure 3:Stages components of management (roles and functions) in field activities

4.3. Actuating

4.3.1. Analysis (Vision, Mission, Policy)

Analysis (vision, mission, policy) and needs of geothermal field activities as well as lake Linow potential (diversity of manifestations, ecosystem diversity, security and access) to be developed as natural laboratory / field activities

4.3.2. Development Process

The development process of coherent and tiered field activities that adopt the 5E learning cycle model (Engagement, Exploration, Explanation, Elaboration, Evaluate). The principles of the 5E learning cycle adopted become the reference for the formulation of target indicators and process indicators from each stage of field activities. Target indicators and process indicators are formulated in the field activities guide and are a measure of the success of field activities, as well as reflecting the advantages of field management (productivity, efficiency, synergy, and other governance) governance models

4.3.3. Description of Field Activities in Linow Lake

a. Activity level 1 (K1): introduction and attraction of study object
1) Implemented in the first semester - the target students are first semester students
2) Form of activity (grouping):
a) scientific tourism, first semester students introduced with geothermal phenomena, general properties of geothermal conditions, benefits and utilization of geothermal energy and geothermal ecosystems - implemented entirely on site (Linow lake)
b) discussions: experiences of geothermal introduction and events, basic knowledge of geothermal energy use, knowledge of geothermal ecosystem maturity (tourism, health, etc.) - implemented on site
c) Assignment: students reading references, describing travel experiences and discussion results related to reference, writing personal development plans related to knowledge development, skills and affairs of geothermal competence, writing personal commitment in lecturing program and self-supporting activities in gradual development of competence in geothermal fields
3) Implementing activities: 1. lecturer team of field lecturer-1, 2. lecturers team directly related to field activities of level 1, 3. final grade students (who are or have attended field activities level 4)
4) Implementation time: adjusting to the number of students in the first semester, with the target of a student following two field activities
5) Activity indicator: developed based on indicator E1-E2
b. Activity level 2: exploration of study objects and building skills: practicum
1) Implemented in the 3rd to 6th semester
2) Form of activity: lab work
a) Students study the method of measurement, transect stipulation, the principles of determining the location of measurement / sampling
b) Students take measurements of physical and chemical variables (directly in the field or through testing of samples in the laboratory)
c) Students identify and perform measurements at different positions (phenomena in the field) are different, and explain the difference.
(b) objectives and benefits (for the development of competence and personality), (c) literature review (relevant to materials, activities and methods) (d) Students conduct a report on practical activities, methods of measuring and analyzing data, (e) results and discussion, (f) conclusions
3) Implementing activities: 1 lecturer team of field-level activities 2, 2 lecturer team related to practicum activities, 3. final graduate students (who are or have participated in 4-level field activities)
4) Implementation time: for four semesters starting from semester 3 to semester 6. Each student must perform field-level activities four times for four semesters (semester 3 s / d 6). Three activities were conducted as practicum activities of the related lectures, and one activity was conducted as an independent practicum activity. Activity self-directed activities directed as a pioneer for activities level 3 ie thesis research. Activity independent activities can be done through the participation of students as data collectors and data analysis in research thesis more senior students, or research faculty.
5) Activity indicator: developed based on indicator E2-E3
c. 3-level activities: deepening and elaborating knowledge and skills in the field of geothermal through independent research (or collaboration)
1) Implemented in semesters 6 to 8, depending on the readiness and progress of student studies
2) Form of activity: research for thesis
a) Students set the scope and focus of research independently, or elaborated from an umbrella study (for collaborative research design)
b) Students design research scenario containing research steps, research variables, research methods (determination of transects and measurement positions), data analysis methods based on the results of comparative research and general reference. This basic draft is consulted with the team of lecturers of field 3, which is to standardize the thesis research material (especially the research method), the control of research duplication, the direction of research synergy with the framework of geothermal field competence development
c) Students prepare thesis proposal under the direction of the supervisor team determined by the Head of Geothermal Study Program
d) Students undertake proposal seminar activities to get input on the design of research activities and thesis writing
e) Students plan field activities, conduct observation / measurement, analyze the data and compare it with previous research results and references, and write a thesis draft completely
f) Students present research results (scope of research materials, supporting reference studies, research methods, research results and discussion, conclusions and suggestions)
3) Implementing activities: 1. lecturer team of field-level activities 3, 2. thesis supervisor team, 3. final grade students (who are or have participated in 4-level field activities)
4) Implementation time: during semester 6 to semester 8.
5) Activity indicator: developed based on indicator E3-E4.
d. 4th-level activities: comparative, applied and competency evaluation for the development of self-supporting activities in the geothermal field
1) Activity level 4 is directed as an internalization activities of student competence related to sensitivity, concern for geothermal problem.
2) Form of activities: 1. research development (comparative to the dives in research thesis), 2. perform assistance (mentoring and direction) for other students in doing field activities level-1, ladder-2 and ladder-3, 3. made a literal text related to the results of the study, 4. made research on geothermal issues / problems. Each student is required to conduct field activities (or development of field activities) level 3, by selecting one or more focus activities mentioned above
3) Implementing activities: 1. lecturer team of field-level activities 4 and head of study program, 2. partner institution directly related to the implementation of research partnership activities, seminars and so on.
4) Implementation time: during semester 7 to semester 8.
Activity indicator: developed based on indicator E4-E5

4.4. Controlling

1. The result of application of format-1 (phase of engangment-exploration)
The results of the study using format 1 indicate that in the early field activities (semester I and semester II), the student group is highly motivated by recognizing geothermal phenomena and manifestation forms, and performing simple measurements (land surface) and performing a simple analysis of phenomenal relationships or physical variables, chemistry and biology. This proves that in the phase of engagement and exploration, the integration model of field activities with lectures will contribute activities and achievements of physics learning (geothermal).
2. Value of group assignment in working on format-2 and format 3
The results of the study using format 2 and format 3 indicate that the student group task value increased from the initial meeting to the end. This shows that the facilitation function of learning by the lecturers and the end-level students contributes significantly to the process of performing tasks and mastery of task material by the student groups. The mastery of the relationship between the context (facts and observed phenomena) to the context, the identification of physical variables on phenomena and the formulation of relationships between concepts explaining phenomena can be increased from the initial meeting to the final meeting. This indicates that the design of field activities can motivate the learning group in doing the task, build the learning initiative and can improve the mastery of the concepts related to the observation and measurement in the field

5. Conclusion

Based on the results of research and data analysis it can be concluded as follows
5.1. Geothermal area of Linow lake is a geothermal area covering Linow lake area, surrounding land consisting of open land / forest, forest, plantation area
5.2. Result of identification of geothermal manifestation of geothermal area of Linow lake, produces six zones that can be used as the location of practicum activity and field research of physics majors
5.3. Management of field activities can support the physics lecture to achieve the competence of graduate students who comprehensiveness.

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