

EXPLORATION OF MANGROVE ECOSYSTEM AMONG TEACHER TRAINEES THROUGH INQUIRY

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ABSTRACT

This study aims to explore the 5E elements mastered by trainee teachers in the exploration of mangrove swamp ecosystem through inquiry method in Mangrove Forest, Johor. The research participants of this qualitative case study was involved two teacher trainees from Institute of Teacher Education Technical Education Campus Study. The research data were obtained through observations, documents and unstructured interviews. The findings showed that trainee teachers have high curiosity, acquire 'big ideas' on the issues studied, able to solve problems, build new ideas that are more diversified and structured and build and apply new science concepts in new situations. The results of the evaluation of drawings, writing and peers showed that the level of knowledge of trainee teachers increased after the process of exploration. In conclusion, this study may serve a guide in exploration activities at real field sites through inquiry-based learning for enhance scientific knowledge and concepts towards the growth of environmentally-smart citizen.

Keywords:

Mangrove forest, Ecosystem, 5E phases, inquiry, teacher

ABSTRAK

Kajian ini bertujuan untuk mengeksplorasi elemen dari pembelajaran 5E yang dikuasai oleh calon guru mengeksplorasi ekosistem hutan mangrove dengan metode inkuiri di hutan mangrove Johor, Malaysia. Penelitian ini berbentuk kualitatif dengan melibatkan obyek berupa dua orang mahasiswa calon guru di Institut Pendidikan Guru Kampus Pendidikan Teknik. Data penelitian diperoleh melalui observasi, dokumen dan wawancara tidak terstruktur. Hasil penelitian menunjukkan bahwa mahasiswa calon guru memiliki perasaan ingin tahu yang tinggi, mampu memperoleh 'big idea' mengenai isu yang dikaji, berupaya menyelesaikan masalah, mampu membangun idea baru yang lebih beragam dan terstruktur. Serta membangun dan mengaplikasikan konsep sains dalam situasi yang baru. Hasil evaluasi dari gambar, tulisan dan penilaian teman sebaya menunjukkan bahwa level pengetahuan mahasiswa calon guru meningkat selepas proses eksplorasi. Kesimpulannya, penelitian ini dapat berfungsi sebagai panduan dalam pelaksanaan aktivitis eksplorasi di lapangan sebenarnya melalui pembelajaran berbasis inkuiri untuk meningkatkan pengetahuan dan konsep saintifik dalam kerangka menumbuhkan generasi yang cerdas terhadap alam sekitar.

Kata kunci:

Hutan mangrove, Ekosistem, Fase 5E, Inkuiri, Guru

INTRODUCTION

Background of the study

Sustainable development of SDGs 2030 is seen as one of the most proactive and practical modern development ideas to address issues between development and environmental conservation claims (Hopkins & McKeown, 2002; Sterling, 2003; Scoullos & Malotidi, 2004; Moroye, 2005; Hazura, 2009). The world community is concerned about issues of environmental exploitation, economic development and deteriorating

quality of life (Osman, 2005). At the same time, development activities and neglect of environmental aspects also threaten the future of generations. It is undeniable that this condition is very serious and affects the survival and sustainability of civilization and prosperity (Laily, 2009).

The concept of sustainable and environmentally friendly development of the country will be achieved by providing environmental education to the human race. Global issues such as food shortage, population density, water pollution, land

degradation, conservation, pollution and use of chemicals in agriculture, energy crisis and species extinction can only be understood by knowledge of the surrounding environment and the human relationship with its environment. Basic knowledge such as ecology allows humans to solve environmental issues related to science, social, political, economic, cultural and religious because without the knowledge and education of the environment, the balance of the natural ecosystem will not be addressed and preserved. The importance of environmental education can be seen in the efforts of governments that place serious emphasis on all sectors of society ranging from the early childhood education to the university (Mahat et al., 2013).

Statement of Problem

In accomplishing teacher success, trainings provided to teacher trainees are now seen as a difficult task in overcoming the obstacles and challenges, for instance in delivering knowledge regarding the environment. According to Alizah and Zamri (2015), the teaching and learning process at higher education is often found to be more likely to use lectures as the main teaching technique. Teaching using lectures can sometimes be tedious and can lead to drowsiness besides resulting in passiveness among teacher trainees. This is because, when lecturers deliver lectures, students are often found to be just listeners by not involving themselves in the teaching and learning process and thus resulting in the absence of two-way communication between lecturers and students (Alizah & Zamri, 2015). This makes it difficult for teacher trainees to understand the lessons in detail, especially when it comes to the topics concerning the environment. The destruction of mangrove ecological areas is increasingly due to human greed for profit. According to Ismail (2017), the shift of mangrove areas for development over the past 50 years in most developing countries has resulted in the loss of mangrove forests at more than

one percent per annum. This environmental issue stems from the poor implementation of EE in the national education system. Various efforts have been taken by all parties but these efforts are still at a dead end. The 1976 Cabinet Report to the 11th Malaysia Plan emphasized environmental issues through education, but the achievement of environmental literacy has not been fully realized (Rahman et al., 2018). Therefore, the implementation of EE should be noted through the effective teaching methodology approach that teachers should take into account so that the implementation of EE can be instilled in students early on. However, 21st century pedagogical practices such as the Inquiry Approach cannot be applied to environmental learning due to lack of expertise in educators. According to a study conducted by UNESCO (2011) that shows that teachers teach only to meet exam requirements.

Research Objective

This study aims to explore the elements of 5E mastered by teacher trainees during exploration of Tanjung Piai mangrove swamps.

The objective of this study is to:

1. Explore the 5E elements mastered by teacher trainees in the exploration of mangrove ecosystems?

MATERIALS AND METHODS

Research Design

For the purpose of this study, the research design is qualitative study, by conducting a case study at Tanjung Piai Mangrove Forest, Johor. According to Yin (2009), case study is defined as a form of empirical inquiry conducted to study contemporary phenomena occurring in real life context. A qualitative approach was chosen in this study to explore methods of collecting information from mangrove forests through inquiry based on several factors. First, the appropriateness of exploring areas that have not been

investigated previously and providing a detailed understanding of the phenomena studied (Creswell, 2002). Second, qualitative research has its limitations, unable to provide a rich and detailed perspective. Third, qualitative research helps researchers understand the process and benefits of gathering information through an inquiry-based approach. According to Merriam (2002), case study is a form of study in a closed systems to identify the meaning and understanding of a situation or subject. In case studies, researchers are considered to be the key instruments in the process of collecting and analyzing data.

Research Site

The research area selected is Tanjung Piai Mangrove Forest, Johor. Several criteria were set by the researcher before selecting the research location. Among the criterion is abundant mangrove habitat and no damage to the vegetation as it is a reserved forest. Furthermore, the Tanjung Piai mangrove forests are one of the educational ecotourism, where there is a wealth of information available to tourists while visiting the mangrove forests.

Research Profile

The research participants consisted of two 7th semester June 2016 intake teacher trainees from Institute of Teacher Education Technical Education Campus. In this study the research participants were 22 years old. There were only two participants involved in this study as Patton (1990) stated that no rules were set in sample size selection in a qualitative study, but sample size depends on what the researcher wants to explore, performed in a timely manner besides allowing the research to obtain in-depth information.

This view is in line with Merriam (2009) saying that the selection of potential participants enables the acquisition of information to the point where no new information is found or overlapped.

In addition, the sample selection used in this study was the purposive sampling method. This is because, the choices made are intentional to specific individuals, events and environments based on significant information that will allow the researcher to explore further of the phenomenon that is being studied (Creswell, 2014).

Research Methods

The researcher has chosen three research methods: unstructured interviews, observations and documentation. Interview is the main instrument in the process of gathering information. This is because, the quality of the interview data often depends on the words and behavior of the participants. Researchers can therefore gain a better understanding of the language and behavior of the participants during the interview. Therefore, the role of the researcher as a research instrument is important. This is in line with the views expressed by Marohaini (2001), who stated that researchers are a key research instrument and requires knowledge and skills to interact with the people around them.

Interview

The researcher focused on semi-structured interview method because according to Gay et al., (2006), semi-structured interview allowed follow-up questions to be asked based on the answers provided for more explicit information. While Merriam (2009) asserts that face-to-face, semi-structured interviews can help researchers obtain accurate data based on issues they wish to explore. The study protocol was used to guide the researcher to guide the conduct of the research.

Observation

Observations was conducted to obtain data on 5 learning phases used by teacher trainees to obtain information on mangrove forests. When conducting observations researchers requires existing

senses such as sight, touch and smell to obtain information from the environment. As Patton (1990) also points out, observations should be organized, spontaneous and recorded using senses with the purpose of seeing, hearing, feeling, observing and asking questions that may lead to interviewing participants for more realistic information. Observations are made for the purpose of collecting “non-verbal” data to examine real-life situations or events, while critically considering the behavior of the participants.

Documentation

The researcher has chosen an unofficial document which is providing the participants with issues to resolve. According to Creswell (2008), documentation is an important source of data to support the data from interviews and observations, besides documentation can provide very useful information in assisting researchers to understand a phenomenon that occurs and as actual real evidence. In addition, Merriam (1998) states that there are two types of documentation commonly used in qualitative studies: formal and informal documentation. The researcher has chosen an unofficial document which is providing the participants with issues to resolve.

Data Collection

The research data were obtained through triangulation results between several data sources through interviews, observations, and documentations. Creswell (2014) specified that processes involving supporting evidence from a variety of sources facilitate the understanding of a theme or perspective in analyzing data. Marohaini (2001) also stated that the use of triangulation techniques such as data collection from various sources can not only support and add evidence but also help validate the information obtained from interviews and observations.

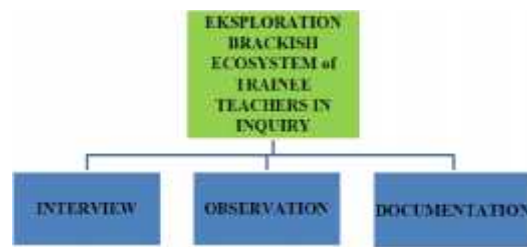


Figure 1. Data collection techniques

Data Analysis

After collecting data the researcher has to go through the process of analyzing the data. The researcher plans and manages the data in three steps namely managing the data, understanding the data and analyzing the data. Frequent and prominent phrases and issues are identified and matched to the research questions. Encoding is done next to transcriptions to form themes and patterns.

Interview Analysis

The process of analyzing the interview instrument goes through three stages starting with video recording (interview), transcription (processing of written data) and analysis (qualitative and quantitative data acquisition). The interview was transcribed into written data to facilitate data analysis work. In order to facilitate the researcher in the process of data analysis a coding system was developed.

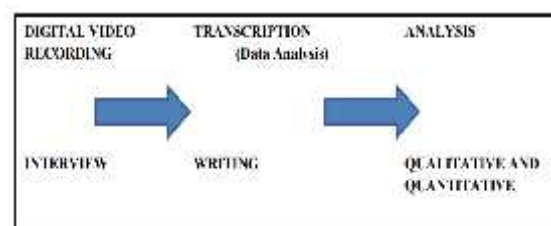


Figure 2. The process of analyzing interview data

Documentation Analysis

The use of documents to collect information is used by the researcher to test the acquisition of information by the participants. The document provided is to enhance the level of inquiry within the

participants to further explore the ecosystem found in mangrove forests. Documentation analysis is also done according to the generated code.

Observation Analysis

The method of collecting data through observation is to answer the questions given in the document. The researcher will evaluate the methodology involved in collecting information in the mangrove forests based on the 5E learning model. As the participants gather information, the researcher will refer to the observation protocol containing the 5E learning model. The data code was generated to facilitate the researcher in the process of analyzing the findings.

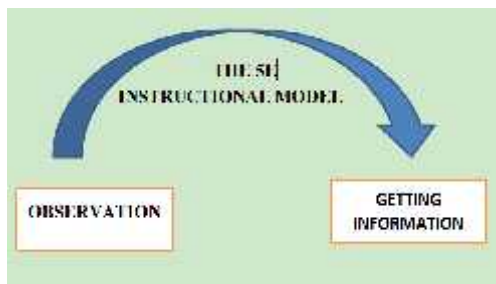


Figure 3. Methods of analyzing observation data.

FINDING AND DISCUSSION

The findings are a reflection of the researcher's interpretations of the data obtained in the form of unstructured interviews, observations and documents and even the data are analyzed to answer the questions raised in the study, which is the element of 5E mastered by teacher trainees in exploring mangrove ecosystems.

i. Curiosity about 'the big idea'

The findings from the section show that the teacher trainees' knowledge of the ecosystem is the result of the implementation of 5E phase. The Engagement phase shows that there is a growing sense of curiosity for the teacher trainees about 'the big idea' they want to convey. The findings also show that existing understandings and misconceptions can be

traced to this stage [RB(1)1-15/9(line 38-43)]. This finding was obtained from interview data with the participants.

Researcher : What do you think is the type of leaf vein found in plants in the first zone of mangrove forests?

Aminah : Well, maybe every kind of mangrove tree here has a different kind of leaf. There may be a lush mangrove tree or a symptom of a mangrove tree type.

RB (1)1-15/9(line 38-43)

In addition, this finding was also supported by interviews conducted with Ahmad [RA (1) 1-15/9 (line 44-48)]. The interview found that the teacher trainees expressed a strong interest in the exploration of mangrove forests to obtain information on the types of mangrove swamps available in the area. Interview data with the teacher trainee explains that they have a curiosity to discover new information.

Researcher : Why do you have to explore mangrove forests?

Ahmad : For more information on mangrove swamps Because I only know one kind of mangrove tree, which is a mangrove tree. I used to see them on TV! But looking at the real thing is exciting to know more!

RA (1)1-15/9(line 44-48)

This data is also supported by the second teacher trainee interview data [RB(1)1-15/9(line 45-47)], which also indicates an interest in getting information on mangrove forests. This clearly arises the curiosity of the teacher trainee.

Researcher : Why do you have to explore mangrove forests?

Aminah : To solve the problem given. As well as gaining useful new knowledge on mangrove forests.

RB (1)1-15/9(line 45-47)

ii. Building concept understanding based on first-hand experience

The exploration phase is the phase for activities that encourage the teacher trainee to work together to obtain the information needed. This phase is the phase in which the teacher trainee conduct a field study which is first hand experience. This will enable the teacher trainees to think openly within the scope of the questions being investigated through exploring and discussing alternatives to obtain maximum information. After analyzing the interviews, documentations and observations revealed that there were 2 themes that the teacher trainee developed in understanding the concept of “first hand experience” and solving given problems.

For the exploration phase, the findings shows that the teacher trainees can build understanding based on the concept of “first-hand experience” that requires the teacher trainees to resolve the problem directly with the surrounding environment. Interview data for both RA and RB indicated that the teacher trainee were confident in acquiring and building knowledge of plant species in each zone found in the mangrove forests during field studies.

Researcher : What kind of plant species are in the zone found in mangrove forests?

Aminah : There are lots of ‘*pokok bakau api-api*’, ‘*bakau kurap*’, ‘*bakau tengar*’, ‘*bakau kurap*’ and ‘*bakau minyak*’
RB (1)l-16/9 (line 39-41)

Researcher : What kind of plant species are in the zone found in mangrove forests?

Ahmad : Emm, theres a lot of mangrove trees around here, some of it are ‘*pokok bakau minyak*’, ‘*bakau kurap*’, ‘*bakau tengar*’, ‘*bakau tumu putih*’, ‘*bakau lenggadai*’. These trees grow in their own zones.
RA (1)l-16/9 (baris 30-35)

In addition, the observation note [RA (1) CP-16/9 (p. 5)] and drawing (Figure 4) showed that the participants discussed how mangroves cope with low oxygen levels during high tide, and that mangroves process a gas exchange mechanism.

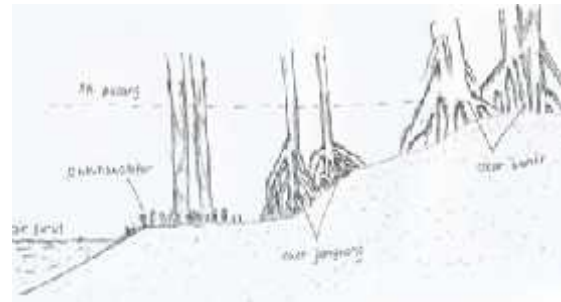


Figure 4. Sketches drawn by the participants

Pneumatofor or Respiratory Root is a vertical root that rises from the ground and is shaped like a pencil. This root extends out from the root of the cable and assists in the exchange of gas between the submerged root and the atmosphere (for example the Api-api tree).

RA (1) CP-16/9 (p. 5)

In fact, the second study also showed that the participants able to gave examples of how mangroves can adapt to oxygen deficiency problems.

The knee root is also similar. It is a curved root root and appears on the surface of the soil (for example, the *Tumu Merah*). Small holes of lenticillary are present at the knee root for the process of gas exchange.

RB (1) CP-16/9 (p. 6)

The data through video recording (figure 5) also proves that participants are capable of carrying out 'hands-on' activities. This activity allows the participants to conduct exploration on the research site (mud trail) to find information on plants and animals found in mangrove swamps.



Figure 5. Research at Mud Trail

iii. Problem solving

Analysis of observations through the video recordings (figure 6) shows that the theme of problem solving occurs when a teacher trainee traverses mangrove forests to complete a given task. It appeared twice as observation for participants (Ahmad and Aminah, not real names). Each exploration is to fill out the documents provided and note taking. Through the observation notes [RB (1) CP-16/9 (p. 6)] the participants paid high attention and commitment when collecting information.



Figure 6. Carrying out investigation activities on types of roots

This is supported by the data obtained through interviews [RB(1)1-17/9 (line 39-41)]. Teacher trainee Aminah confirms that the method of exploring is done to solve the problem presented in the document provided.

Researcher : How do you solve the given problem?

Ahmad : To solve the problem I have scoped the entire area of mangrove forests to collect the characteristics of each mangrove tree. I gained a lot of information by exploring these mangrove swamps. I got information from forest officials as well as information on this area.

RB (1)1-17/9 (line 39-41)

In fact, the participants explored using the PlantSnap application (Figure 7) provided in the phones to obtain information about the characteristics of each mangrove swamp.

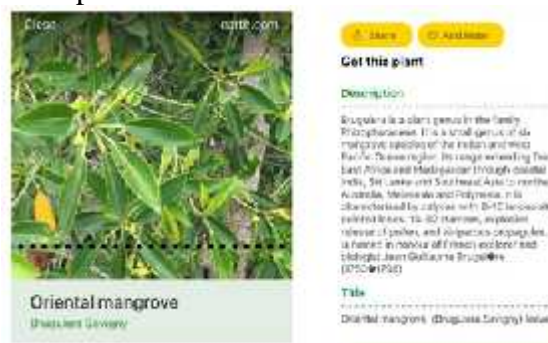


Figure 7. Teacher trainees explores the PlantSnap application available on mobile phones

Unofficial document analysis supports this finding as the participants look in more detail at the characteristics of each subject. The participants produced an unofficial document DTR (01) (Figure 8) 1, which outlines differences in root, flower and fruit types as different reproductive agents.

Jenis-jenis Pokok Bakau	Akar	Rumput	Buah
Jenis Bakau (Rhizophoraceae) - Bakau Minyak - Bakau Kurap			
Jenis Api Api (Avicenniaceae) - Api-api Putih - Api-api Jambu - Api-api Lerdal	Akar Pernafasan/ Pneumatofor		
Jenis Perepat (Sonneratiaceae) - Perepat - Perampang - Gedabu	Akar Pernafasan/ Pneumatofor		
Jenis Tumu (Burseraceae) - Tumu merah - Berus - ...	Akar Lutul		

Figure 8. Main mangrove trees in the mangrove plain

While, the Explanation phase shows that the teacher trainees have the ability to inform and develop new knowledge and structured ideas about the mangrove ecosystem. As the information activity unfolds, new ideas are generated around the information gained. Themes appear when the analysis of interviews, observations and documentations is carried out.

iv. Explaining and developing ideas

During the explanatory phase, the findings indicate that the participants made their own statements to ensure accurate information retrieval. As the description activity continues, new ideas emerge about the information gained. Themes appear when the analysis of interviews, observations and documentations is carried out. Interview data [RA(1)1-17/9 (line 67-71)] with the participants indicated that they had many discussions to explain the information obtained from each other.

Researcher : What do you do after collecting information?

Ahmad : I held discussions with Aminah to ensure that the information obtained is accurate and appropriate for use. Also, I can find out about the information I've not encountered.

[RA(1)1-17/9 (line 67-71)]

The observation notes indicate that the participant (RA) able to explain to his friend the mechanism for controlling salt concentration in plant tissue (figure 9).

The salt gland is present in the leaves, it works to get rid of the salts that are absorbed by the root (for example, the Guava and Ginger). In addition, the process of salt storage and removal must be done through the process of leaf removal so that mangroves can survive!

RA (1) CP-16/9 (ms 6)

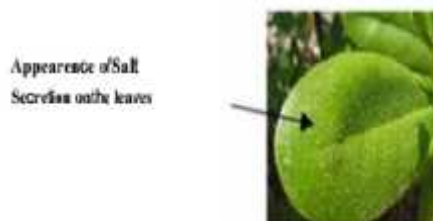


Figure 9. Salt removal

Data via video recording [RA (1) RV-16/9] also proves that during the explanatory phase, the teacher trainee develops new ideas after the activity. In tense environments such as strong waves and unstable soil, the rate of germination and survival of seedlings is low. Therefore, mangroves have a special way of breeding. The teacher trainee is capable of developing new ideas as a result of peer discussions by explaining in detail each breeding process for mangrove species.

Viviparous reproduction is when the seeds germinate and grow while the seedlings are still attached to the stem (for example *Pokok Bakau Minyak*, *Bakau Kurap*, *Tumu* and *Berus*). This allows for rapid growth

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of seedlings when the seedlings are removed from the parent tree and fall down the ground.

RA (1) RV-16/9

This data is also supported by unofficial documents (Figure 10) in which the participants made detailed sketches of viviparous reproduction.

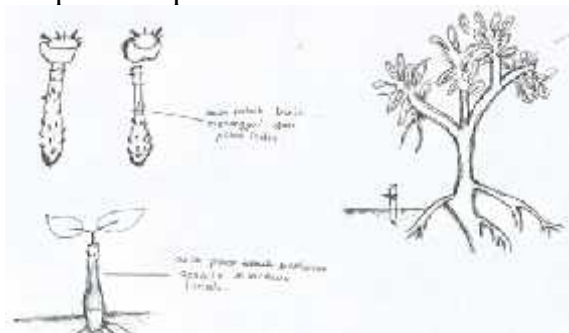


Figure 10. Sketches of viviparous reproduction.

v. Phase repeats

Through this phase the teacher trainees can gain an understanding of the terminology, definitions, models and analogies gained as a result of the discussions. Through RB observation analysis [(2) O / CP-16/9] found that when participants of the RB study through acquiring new information and repeating from the engagement phase-> exploration phase-> description to collect new information. The phase repeats of the research was initiated by the engagement phase when the curiosity arises to obtain new information obtained as a result of the discussion during the explanatory phase.



Figure 11. Phase repeats when new ideas are added

The result of the Elaboration phase of the study found that the teacher trainees was able to practice the "big idea" concept by solving the problems presented and can apply two different science concepts. This can be seen in the field notes through observations between RA and RB. Observational data were obtained through discussion among participants RAB (1) O / CP-16/9 (pages 5-6)].

- Aminah : How do you get information on leaf and stem features?
 Ahmad : I looked at the available billboards. There is a lot of information about mangrove swamp traits that can be obtained, not necessarily from close observations. Information on the first feature of the tree is also taken from this bulletin board.
 Aminah : There is also a lot of information available.
 RAB (1) O / CP-16/9 (pages 5-6)

In the final phase of Evaluation, the findings found that teacher trainees carry out assessment through a variety of methods and assignments through self and peer assessment in the process of finding the accuracy of information. Formative assessments are conducted to record the achievement of the teacher trainees at each phase and to identify the effectiveness and quality of each level. The assessment is to determine the quality and the methods used to enhance the knowledge of the participants which is the final product. Analysis of the DTR01 document (15/9) found that the participants made an assessment of the drawings and the text produced after collecting the information. The research participant reviewed every detail of the sketches drawn to ensure that the features found were in line with the mangrove trees. Information obtained was self-assessed by the participants.



Figure 12. Document showing the assessment performed

In addition, observation data were obtained through discussions between RA participants through RAB (1) O / CP-16/9 (Figure 12) which were verbally stated method of drawing the leaf features correctly. The participants showed the correct method of drawing the knee root.

- Ahmad : Aminah!! You drew the knee roots incorrectly... Instead of drawing it upwards it should be blended towards the ground. If you draw it upwards it'd be respiratory roots not knee roots
- Aminah : Ehh ya I didn't notice. Thank god you told me.
 RAB (1) O / CP-16/9 (page 6)

The overall findings of the research question, "What are the 5E elements that the participants have in the exploration of mangrove ecosystem?" shows the emergence of several themes for each phase. The finding shows that the explorations of the mangrove ecosystem using the 5E element could increase the level of inquiry within the teacher trainees as the participants' knowledge level increased. The teaching method of inquiry is to help students develop skills and intellectual discipline in raising questions and finding answers to their questions.

Figure 13 below shows the summary of findings and discussion for the research questions "What are the 5E elements that the research participants have mastered in the mangrove ecosystem exploration?"

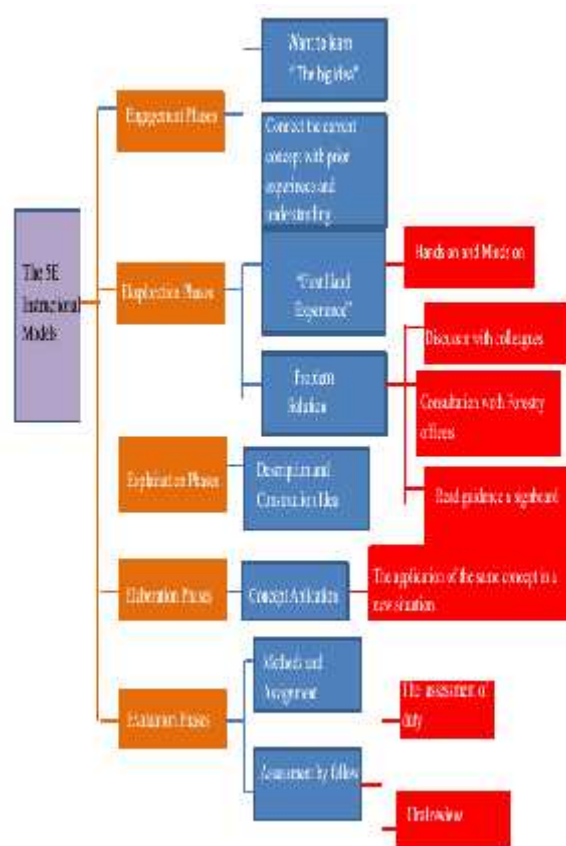


Figure 13. Summary of research findings

The findings show that knowledge of animals, plants, habitats, natural cycles has been explored by teacher trainees through the activities of inquiry approaches and that this learning process has profound implications for the basic concepts of the environment. This is because the teacher trainees solves the problem presented by completing the task correctly. Other than that, Palmer and Neal (1994) states that environmental education is a process of student exploration in enhancing knowledge of nature and the natural processes taking place in their natural environment. In fact, the acquisition of knowledge and understanding of the environment enables students to take responsibility and appreciate the concepts and facts of nature in their environment.

The finding also shows that the first information the teacher trainees explored was about mangrove swamp characteristics. The characteristics of mangroves are due to

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the adaptation made by mangroves to survive in muddy areas such as mangrove forests. According to Aksornkoe (1993), Zottoli (1978) and Khairuddin (1992) mangroves adapt to environments such as high water pressure, salinity and lack of fresh water through roots to grasp wetlands as well as respiratory roots, soil seeding methods and salt dispersal processes through leaves. This is in line with the theme that emerged when the teacher trainees conducted a research of the characteristics of leaves and root types of mangrove swamps.

Research on Environmental Education needs to be taken into consideration and highlighted from time to time to identify its impact on the community, especially on students (Chawla & Cushing, 2007; Rickinson, 2001) Teachers are the driving force behind students' success in caring for the environment. Effective information delivery methods are key to attracting students to apply global sustainability practices in the daily lives of students. The contents of the Environmental Education which are intended for dissemination to schools and the public should be made to meet current demands and requirements so that the quality of education can be improved.

CONCLUSION

Research on Environmental Education needs to be taken into consideration and highlighted from time to time to identify its impact on the community, especially on students In this context, the involvement of studies on effective teaching methods such as inquiry learning and field studies is essential for student-centered teaching on environmental preservation. This awareness is expected to be expressed through positive interactions with the environment.

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