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Preliminary Study on the Development of a Lip Learning Model Based on the Local Potential of Taba Vulkan Gamalama for Improving Students' Chemical Literacy

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This research is a preliminary study in the form of a needs analysis as a guide in developing a LIP (inquiry training-project) learning model based on the local potential of Taba (sand land and batu angus) Gamalama volcano to increase students' chemical literacy. This research was carried out through observation, distributing questionnaires and literature studies regarding the LIP learning model based on Taba's local potential to increase students' chemical literacy. The research method used is descriptive qualitative with data collection techniques, namely observation, questionnaires

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and Discussion. The subjects of this research were students in the Chemistry Education Study Program in the inorganic chemistry course. The sample used was a saturated sample with a total of 52 students. This research is the initial part of a series of Research and Development models. The research results show that the chemical literacy of Indonesian students is still low, which is based on the results of the 2022 PISA assessment by the OECD, namely that Indonesia is in 67th position out of 81 countries with a score of 383, and the observation results as needs analysis data obtained 100%, not yet using the LIP learning model (inquiry training-project) based on the local potential of Taba Vulcan Gamalama during chemistry learning. Based on the results of the preliminary study that has been carried out, it shows that it is necessary to develop a LIP learning model based on the local potential of Taba Vulcan Gamalama to increase the chemical literacy of prospective teacher students.

Keywords: LIP learning model; local potential; chemical literacy; qualitative discrimination.

1. INTRODUCTION

Education is very important in the 21st century, to ensure that students or learners have the ability or skills to learn, face life, innovate and be creative in line with the increasingly rapid development of science and technology (science and technology). Regarding the competency or ability of students in higher education that can be measured to show the quality of education, one of them is chemical literacy ability.

Chemical literacy is part of scientific literacy [1–3]. Chemical literacy is related to how students' abilities can utilize chemical knowledge with the technology they master to apply it in daily life.

Assessing chemical literacy can use the suitability between the PISA (Program for International Student Assessment) scientific literacy assessment framework by [4] OECD (2016) including aspects: knowledge, context, competency and attitude.

PISA assessment results data reported by the OECD (Organization for Economic Cooperation and Development) in 2022, shows that the science/chemistry literacy skills of students in Indonesia are still low. The low chemical literacy skills of students in Indonesia are because chemistry material is still considered difficult by some participants students, and have not been able to apply chemical concepts in daily life, thus affecting students' chemical literacy abilities. As can be seen from survey data from

PISA 2022 by the [5], showing Indonesia in 67th position out of 81 countries with a score of 383. The results of PISA 2022 show a decline in international learning outcomes due to the pandemic, but Indonesia's ranking in PISA 2022 will increase compared to 2018 (389) due to the resilience of the Indonesian education system in coping learning loss to the pandemic.

In line with the results of the initial study in the 2022-2023 academic year which was carried out for students of the Chemistry Education Study Program, FKIP, Khairun University, observation data was obtained that students' active learning attitudes were still very lacking, which would affect chemical literacy results. This can be seen during teaching and learning activities, few students participate in asking or answering questions from the lecturer. On average, in one class only two or three people dare to ask questions to the lecturer. The reason why students are less active during teaching and learning activities is because 70% of students still feel afraid or reluctant to ask their friends if they want to ask questions [6].

Based on the problems described in this preliminary study, it will be used as reference material or a source for developing a LIP learning model based on the local potential of Taba Vulcan Gamalama to increase the chemical literacy of prospective teacher students.

Taba Vulcan Gamalama offers a rich local potential that can be utilized as a learning resource. This includes natural resources such as sand and batu angus (a type of stone), which can be used to enhance inorganic chemistry learning. The local potential of Taba Vulcan Gamalama includes metallurgy, which is relevant to inorganic chemistry materials.

The volcano's local potential can be integrated into the inorganic chemistry II course, providing a practical and engaging approach to learning. This integration aims to make chemistry more relevant and interesting to students by connecting theoretical concepts to real-world applications and local resources.

Taba Vulcan Gamalama is also an important icon for tourism in Ternate, North Maluku. Utilizing its local potential in education can contribute to the development of the region by fostering a deeper understanding and appreciation of local resources among students.

The study aims to develop a new learning model that addresses the low chemical literacy skills of Indonesian students. By leveraging the unique aspects of Taba Vulcan Gamalama, the research seeks to create a more effective and engaging learning environment that enhances students' abilities to apply chemical knowledge in daily life

2. RESEARCH METHODS

The research method used is descriptive qualitative with data collection techniques, namely observation, questionnaires and Discussion. The subjects of this research were students in the Chemistry Education Study Program in the inorganic chemistry course. The sampling technique was a saturated sample [7], with a total sample of 52 students. The results of the preliminary study include two needs analysis activities, namely field study activities and Discussion. The results of the field study were obtained from observation data and questionnaires distributed, while the results of the Discussion were obtained from books, articles from various reading sources related to chemical literacy and integrated learning models of local potential in the classroom. This research is the initial part of a series of Research and Development models, which refer to the ADDIE model [8].

Here is a detailed explanation of how the observations, questionnaires, and discussions were specifically implemented:

Observations

1. **Setting**: The observations were conducted in the Chemistry Education Study Program at Khairun University, specifically in the inorganic chemistry course.

2. **Purpose**: The primary goal of the observations was to understand the current practices and challenges in teaching inorganic chemistry.

3. **Content**:

   - **Classroom Observations**: Researchers observed classes where inorganic chemistry was being taught. They noted the teaching methods, student participation, and any use of local resources.
   - **Student Activities**: Observers monitored students during practical sessions, noting their engagement and any instances where they applied chemical concepts to real-world problems.

4. **Data Collection**:

   - Researchers used a structured observation guide to ensure consistency in data collection.
   - They recorded notes on the frequency and nature of student participation, the use of local resources, and any instances where students demonstrated chemical literacy.

Questionnaires

1. **Design**:

   - The questionnaire was designed to gather data on students' perceptions and experiences related to the use of local potential in chemistry education.
   - It included both open-ended and closed-ended questions to capture a range of information.

2. **Content**:

   - **Open-Ended Questions**:
   - "What do you think about using local resources like sand and batu angus in chemistry lessons?"
   - "How do you feel about the current teaching methods in inorganic chemistry?"
   - **Closed-Ended Questions**:
   - "Have you ever used a learning model based on the local potential of Taba Vulcan Gamalama in your chemistry lessons?"
   - "Do you think using local resources makes chemistry more interesting?"

3. **Distribution Process**:
   - The questionnaires were distributed to a sample of 52 students from the Chemistry Education Study Program.
   - Students were asked to complete the questionnaires during class time or submit them via email.

4. **Data Analysis**:
   - Responses were analyzed using thematic analysis to identify common themes and patterns.
   - Quantitative data from closed-ended questions were summarized using frequencies and percentages.

Discussions

1. **Purpose**: The discussions aimed to gather more in-depth insights from students, lecturers, and experts in the field of chemistry education.
2. **Participants**:
   - Students from the Chemistry Education Study Program.
   - Lecturers teaching inorganic chemistry.
   - Experts in chemistry education and local resource utilization.
3. **Format**:
   - **Focus Groups**: Small groups of students, lecturers, and experts were formed for focused discussions.
   - **Interviews**: One-on-one interviews were conducted with key informants to gather detailed information.
4. **Topics**:
   - **Current Practices**: Discussions centered around the current teaching methods and the use of local resources in chemistry education.
   - **Challenges and Opportunities**: Participants were asked to share their experiences with using local resources and any challenges they faced.
   - **Suggestions for Improvement**: Participants were encouraged to suggest ways to integrate local potential into the curriculum.
5. **Data Collection Tools**:
   - Audio or video recordings were used to capture the discussions.
   - Notes were taken during the sessions to supplement the recordings.
6. **Data Analysis**:
   - Transcripts of the discussions were analyzed using thematic analysis to identify key themes and patterns.
   - Quotes and excerpts were used to support the findings and provide rich data.

Integration of Methods

1. **Triangulation**: The use of multiple methods (observations, questionnaires, and discussions) helped to triangulate the data, increasing the validity and reliability of the findings.
2. **Consistency**: The structured observation guide and questionnaire ensured consistency in data collection across different participants.
3. **Comprehensive Insights**: The combination of methods provided comprehensive insights into the current state of chemistry education, the challenges faced, and the potential of using local resources to improve chemical literacy.

3. RESULTS

The preliminary study is initial research or initial needs analysis carried out in order to develop a LIP learning model based on the local potential of Taba Vulkan Gamalama to increase the chemical literacy of prospective teacher students. Through initial research, an analysis of user needs will be obtained regarding the learning model product that will be developed. Preliminary studies were carried out through needs analysis, namely through field study activities and literature studies. In general, the preliminary study produces:

3.1 Data from Field Studies

Field study activities were carried out through observation activities and distributing questionnaires. Observation activities and distribution of questionnaires have been carried out to obtain data related to the use of a model based on the local potential of Mount Gamalama in inorganic chemistry lectures at the Chemistry Education Study Program, FKIP, Khairun University. Data from field studies are presented in Table 1.

Based on data from the needs analysis of field study activities, the data in Table 1 shows that there has been no use of a learning model based on the local potential of Mount Gamalama in Inorganic Chemistry lectures at the Chemistry Education Study Program, FKIP, Khairun

University. These results are also supported by needs analysis data from the distribution of questionnaires in Table 1, so the following question is explained about "Have you ever sent assignments via online(e-mail), WA or other using a laptop/notebook/smartphone?"

From the results of Fig. 1, it can be seen that as many as 69.2% of respondents have sent assignments via online(e-mail), WA or other using a laptop/notebook/smartphones, then 30.8% of respondents had sent assignments via online (e-mail), WA or other using a laptop/notebook/smartphones.

Next, the question is explained: Do you think you enjoy studying inorganic chemistry when it is related to daily life?

From the results of Fig. 2, it can be seen that as many as 78.8% of respondents enjoy studying inorganic chemistry if it is related to daily life, then 21.2% of respondents enjoy studying inorganic chemistry if it is related to daily life.

Next, the question is explained: In your opinion, has a learning model based on the local potential of the Gamalama volcano been used when teaching chemistry?

Table. 1 Results of Field Study Activities

No.	Field Study Activities	Results of Field Study
1.	Observation of the use of a model based on the local potential of Mount Gamalama in inorganic chemistry lectures at the Study Program FKIP Chemistry Education Khairun University.	Results of Field Study Activities The observation results show that: a. There has been no use of a learning model based on the local potential of Mount Gamalama in Inorganic Chemistry lectures at the Chemistry Education Study Program, FKIP, Khairun University. b. There are no Inorganic Chemistry learning tools available based on the local potential of Mount Gamalama
2.	Distribution of questionnaires involving 52 people from the FKIP Chemistry Education Study Program Khairun University Academic Year 2022-2023.	The results of the questionnaire showed that 69.2% of students submitted assignments viaon line(e-mail), WA or other using a laptop/notebook/smartphones b. The results of the questionnaire showed that 78.8% of students enjoyed studying inorganic chemistry if it was related to daily life The results of the questionnaire showed that 100% of the learning models based on the local potential of the Gamalama volcano had not been used when teaching chemistry. .d. The results of the questionnaire showed that 73.1% were happy if lecturers used a learning model based on the local potential of the Gamalama volcano when teaching chemistry.

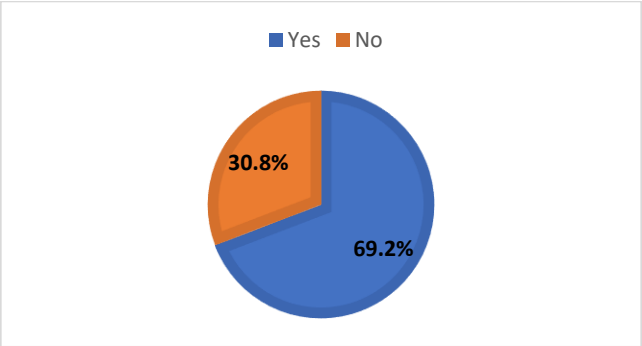

Fig. 1. Diagram of sending tasks viaon line(e-mail), WA or other using a laptop/notebook/smartphones

From the results of Fig. 3, it can be seen that as many as 100% of respondents have not used a learning model based on the local potential of the Gamalama volcano when learning chemistry. Next, the question is explained: Do you think you enjoy studying inorganic chemistry when it is related to daily life?

From the results of Fig. 4, it can be seen that as many as 73.1% of respondents are happy if lecturers use a learning model based on the local potential of the Gamalama volcano when learning chemistry, then 26.9% of respondents were happy if lecturers used a learning model based on the local potential of Vulkan Gamalama when learning chemistry.

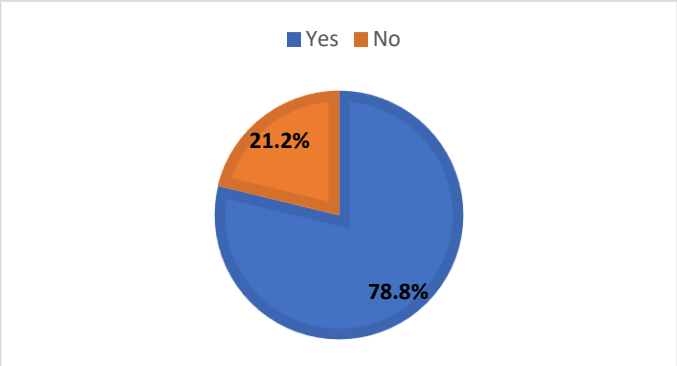

Fig. 2. Diagram of enjoying learning inorganic chemistry if associated with daily life

Fig. 3. Not yet used local potential based learning model Vulcan Gamalama while studying chemistry

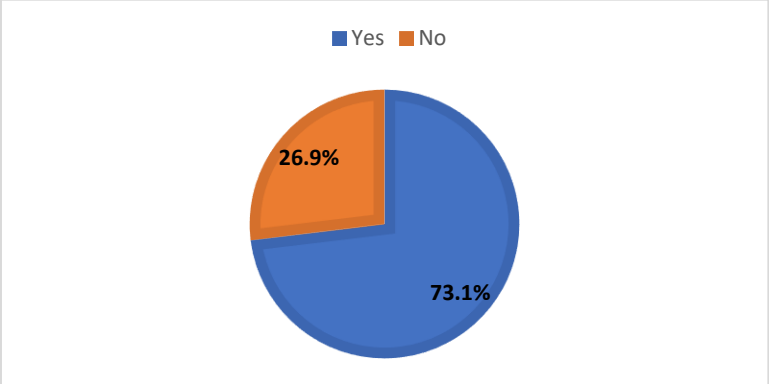

Fig. 4. Happy if the lecturer uses a learning-based model Local potential of the Gamalama volcano when learning chemistry

3.2 Data Collection Process

1. **Observation**:

- **Setting**: The observations were conducted in the inorganic chemistry lectures at the Chemistry Education Study Program, FKIP, Khairun University.
- **Data Collection Tools**: Researchers used a structured observation guide to ensure consistency in data collection. They recorded notes on the frequency and nature of student participation, the use of local resources, and any instances where students demonstrated chemical literacy.
- **Data Sources**: The primary data source for this field study was the direct observation of inorganic chemistry lectures. The observation guide included items such as:
- Frequency of student participation.
- Use of local resources like sand and batu angus.
- Student engagement during practical sessions.

2. **Questionnaires**:

- **Design**: The questionnaire was designed to gather data on students' perceptions and experiences related to the use of local potential in chemistry education.
- **Content**: The questionnaire included both open-ended and closed-ended questions to capture a range of information.
- Open-ended questions: "What do you think about using local resources like sand and batu angus in chemistry lessons?" "How do you feel about the current teaching methods in inorganic chemistry?"
- Closed-ended questions: "Have you ever used a learning model based on the local potential of Taba Vulcan Gamalama in your chemistry lessons?" "Do you think using local resources makes chemistry more interesting?"
- **Distribution Process**: The questionnaires were distributed to a sample of 52 students from the Chemistry Education Study Program. Students were asked to complete the questionnaires during class time or submit them via email.
- **Data Sources**: The primary data source for this field study was the responses to the questionnaires. The data was collected and analyzed using thematic analysis to identify common themes and patterns.

3. Data Analysis Process

1. **Observation Data Analysis**:
- The observation data was analyzed using a structured observation guide to ensure consistency in data collection.
- The data was categorized based on the frequency and nature of student participation, the use of local resources, and any instances where students demonstrated chemical literacy.
- The results were presented in a table format to show the findings clearly.
2. **Questionnaire Data Analysis**:
- The questionnaire data was analyzed using thematic analysis to identify common themes and patterns.
- The responses were coded and categorized based on the themes identified.
- The results were presented in a table format to show the findings clearly.

4. DISCUSSION

Discussion activities consist of: (1) identifying the implementation of chemistry learning in tertiary institutions, (2) analyzing the concept of learning theory, (3) analyzing the relevance of the local potential of Taba (Sand and Angus stone) Gamalama volcano with inorganic chemical materials, (4) analyze the urgency of chemical literacy skills, (5) analyze research results that are relevant to the results of the research conducted. The results of the Discussion are briefly presented by the researchers in Table 2.

Based on the preliminary study that has been carried out, data was also obtained from the analysis of literature studies related to the PISA (Program for International Students Assessment) assessment results reported by the OECD (Organization for Economic Co-operation and Development) in 2022, shows that the science/chemistry literacy skills of students in Indonesia are still low. As can be seen from survey data from PISA 2022 by the OECD [5],

Table 2. Results of Discussion

No.	Discussion Review	Results of Discussion
1.	Implementation chemistry learning in College	a. The clarity of the formulation of Course Learning Outcomes is based on Achievements Learning for undergraduate study program graduates (level 6) includes knowledge/P, general skills/KU & special skills/KK, as well as attitudes/S, which are based on national higher education standards (SN Dikti). b. In chemistry learning, there is no use of a learning model based on the local potential of Taba Vulcan Gamalama.
2.	Learning concept	The results of the analysis of learning concepts are constructivist theory including Piaget's learning theory and Vygotsky's learning theory. b.The concept of the learning model structure is based on [9], namely: syntax, reaction principle, social system, support system, instructional impact and accompanying impact
3.	Relevance of the local potential of Taba vulcan Gamalama with inorganic	The local potential of Taba Volcan Gamalama has relevance with Inorganic Chemical Material, namely metallurgy.
4.	Urgency of ability chemical literacy	Aspects of chemical literacy abilities include aspects of knowledge, context, competency and attiudes.

showing Indonesia in 67 position of 81 countries with a score of 383. The results of PISA 2022 also show a decline in international learning outcomes due to the pandemic, but Indonesia's ranking is in PISA 2022 increased compared to 2018 (389) due to the resilience of Indonesia's education system overcome learning loss to the pandemic. This is supported by research data from [10], showing that chemistry students' chemical literacy skills in waste management material are 73.33%, which is in the medium category. The results of research from [3], obtained a percentage of 77.95%, which shows that high school students' chemical literacy abilities are at a medium level. Refers to these problems and is also based on constructivist learning theory, which understands learning as a process of forming or constructing knowledge by students (Ims.syam-ok.unm.ac.id). Constructivist learning theory includes Piaget's learning theory and Vygotsky's learning theory. As well as the concept of learning model structure from [11], namely: syntax, reaction principles, social systems, support systems.

The inquiry training learning model is also able to increase chemical literacy because learning is student-centered so that students will involve themselves in scientific research. This is supported by research results from [12] that the inquiry model is a learning model that is centered on students through an experimental process to obtain information so that it can improve learning outcomes. The inquiry training learning model is designed to develop skills in scientific investigations and questions that students will seek answers for themselves in order to answer these questions (Nur A.L, et.al., 2021). And the results of the Discussion also showed that the use of the project learning model can also improve student learning outcomes [13,14], also explained that the project-based learning model is an application of active learning, which uses projects in learning so that it can hone students' skills.

In general, there are several stages of inquiry training [9], namely: a) Facing the problem; b) Collect data to verify problems arise and determine hypotheses; c) Collect data through experimental activities; d) Processing data; and e) Analysis of the inquiry process. Students analyze the patterns of discovery or problem-solving strategies they have used. If they find deficiencies, they will try to improve them systematically, reflecting on the process and evaluating the findings. The stages of [15] project-based learning model are: a) Determining basic questions; b) Designing the project plan to be carried out; c) Prepare a schedule; and d) Monitor students in project progress. The results of the Discussion show that the advantages of the inquiry training learning model are a) Learning that emphasizes the

development of cognitive, affective and psychological aspects in a balanced way so that it is much more meaningful; and b) As a strategy that is in accordance with the development of modern learning psychology. The weaknesses of the inquiry training learning model are a) Sometimes its implementation requires a long time so that educators/lecturers find it difficult to adjust to the specified time; and b) Difficult to control student activities and success. The advantages of the project-based learning model are a) Increasing motivation;b) Improve problem solving abilities; and c) Increase collaboration. With weakness The weaknesses of the project-based learning model are a) It requires a lot of time to solve problems; b) Requires quite a lot of costs; c) Many instructors feel comfortable with traditional classes, the instructor plays the main role in the class, and d) There is a lot of equipment that must be provided.

The results of the preliminary study also showed that local potential in an area could be used as a learning resource, including Gamalama or Mount Gamalama in Ternate, North Maluku. The results of the Gamalama volcan include Taba (sand land and batu angus) as a natural resource (SDA) and is one of the icons or issues of tourism is developing nowadays. Apart from these issues, there are also forest, mining, energy, health, food and drink issues that exist on this earth internationally and nationally that can be chosen to be used as learning resources. [16] also explained that local potential can be utilized as a learning resource so as to increase students' knowledge in learning. The local potential of Taba Vulkan Gamalama can be applied in learning because it is a learning approach that implements regional wealth with natural potential as a learning resource. Students will be able to find out the values of the local potential of Taba Vulkan Gamalama which is used as a learning resource. Based on the problems that have been explained from the results of this preliminary study, one alternative solution is to combine the LIP (inquiry training-project) learning model and integrate it with the local potential of Mount Gamalama in the inorganic chemistry II course. Because currently there is no learning model that is integrated with the local potential of Mount Gamalama as a source of learning. These results are also relevant to the data from observations and questionnaires which show that 100% have not used the LIP learning model (inquiry training-project) based on the local potential of Taba Vulcan Gamalama when learning chemistry.

4.1 Specific Reasons for Students Finding Chemistry Difficult

1. **Survey Data Analysis**:

- The survey data collected through questionnaires provided insights into why students find chemistry difficult.
- The open-ended questions allowed students to express their thoughts and feelings about the subject.
- Common themes that emerged from the analysis included:
- Lack of practical application: Many students felt that chemistry was too theoretical and did not provide enough practical applications.
- Difficulty in understanding concepts: Some students reported difficulty in understanding certain chemical concepts, which made the subject challenging.
- Limited use of local resources: The lack of use of local resources like sand and batu angus in chemistry lessons was highlighted as a significant issue.
- Fear of asking questions: The fear of asking questions during teaching and learning activities was also mentioned as a barrier to learning

2. **Discussion Analysis**:

- The discussion sessions provided more in-depth insights into the challenges faced by students.
- The analysis of the discussion data revealed that students felt that chemistry was not relevant to their daily lives, which made it less interesting.
- The use of local resources was seen as a potential solution to make chemistry more engaging and relevant.

3. **Literature Review Analysis**:

- The literature review provided additional insights into the challenges faced by Indonesian students in chemistry.
- The analysis of literature studies related to PISA assessment results showed that Indonesia ranked 67th out of 81 countries with a score of 383 in the 2022 PISA assessment.
- The results of the PISA assessment highlighted the low science/chemistry

literacy skills of Indonesian students, which was attributed to the lack of practical application and relevance to daily life.

By providing a more detailed analysis process and data sources, the research ensures that the data collected is robust and provides a solid foundation for developing the LIP learning model based on the local potential of Taba Vulcan Gamalama.

5. CONCLUSION

The results of the preliminary study show that a LIP learning model based on the local potential of Taba Vulcan Gamalama is needed when learning chemistry which can increase students' chemical literacy. The data obtained from the preliminary study on needs analysis was 100% that the LIP learning model (inquiry training-project) based on the local potential of Taba Vulkan Gamalama was not used when teaching chemistry. It is hoped that with this research information will be obtained in developing a LIP learning model based on the local potential of Taba Vulcan Gamalama to increase the chemical literacy of prospective teacher students.

The researcher suggests to future researcher that if they are going toconduct a preliminary study they must understand the existing limitations. So, that you can carry out better and more accurate preliminary studies. The limitations referred to are in understanding and utilizing time when conducting preliminary studies.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

CONSENT

As per international standards or university standards, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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