

THE SECONDARY SCHOOLS PHYSICS STUDENTS'
READINESS AND PERCEIVED UNDERSTANDING
OF LIGHT AND OPTIC NATURE-BASED
LEARNING: A SURVEY STUDY

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UNIVERSITI PENDIDIKAN SULTAN IDRIS

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THIS DISSERTATION IS SUBMITTED TO UNIVERSITI PENDIDIKAN SULTAN
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2025



DECLARATION OF ORIGINAL WORK

This declaration is made on 6th February 2025

i. Student's Declaration

I **Sandra Thor Kai Ly** D20211099246 from Faculty Science and Mathematics hereby declare that the thesis for Final Year Project name **THE SECONDARY SCHOOLS PHYSICS STUDENTS' READINESS AND PERCEIVED UNDERSTANDING OF LIGHT AND OPTIC NATURE-BASED LEARNING: A SURVEY STUDY** is my original work. I have not plagiarised from any other scholar's work and any sources that contains copyright had been cited properly for the permitted meanings. Any quotations, excerpt, reference or re-publication from or any works that has copyright had been clearly and well cited.

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ABSTRACT

This study investigates the readiness and perceived understanding of secondary school physics students in Sarikei, Sarawak, regarding the implementation of light and optics nature-based learning (NBL). The objectives were to evaluate students' readiness, their perceived understanding of light and optics, and the correlation between these two variables. A quantitative survey with Likert-scale questionnaire design was employed, targeting 100 Form 4 science stream students using cluster random sampling. The validity and reliability of the instrument were tested through a pilot study, yielding a Cronbach's alpha value above 0.8, indicating high reliability. Data analysis was conducted using descriptive and inferential statistics, including mean, standard deviation, and Spearman Correlation, showed that high levels of student readiness and perceived understanding, with significant correlations between students' readiness and their perceived understanding of light and optics in NBL contexts. Students acknowledged the academic and experiential benefits of NBL, highlighting its role in fostering critical thinking and enhancing engagement. The study concludes that integrating nature-based learning into the physics curriculum can improve students' comprehension of complex topics like light and optics. The results suggest that future educators should consider adopting NBL to enrich physics education.



**KESEDIAAN DAN PEMAHAMAN PELAJAR FIZIK SEKOLAH
MENENGAH TERHADAP PEMBELAJARAN BERASASKAN ALAM
SEKITAR MENGENAI CAHAYA DAN OPTIK: KAJIAN TINJAUAN**

ABSTRAK

Kajian ini menyelidik tentang kesediaan dan pemahaman pelajar fizik sekolah menengah di Sarikei, Sarawak, mengenai pelaksanaan pembelajaran berasaskan alam sekitar (NBL) dalam topik cahaya dan optik. Objektif kajian adalah untuk menilai kesediaan pelajar, pemahaman mereka terhadap topik cahaya dan optik, serta hubungan antara kedua-dua pemboleh ubah ini. Kajian tinjauan kuantitatif dengan reka bentuk soal selidik skala Likert telah dijalankan, melibatkan 100 pelajar Tingkatan 4 aliran sains yang dipilih melalui pensampelan rawak kelompok. Kesahan dan kebolehpercayaan instrumen diuji melalui kajian rintis, menghasilkan nilai Cronbach's alpha melebihi 0.8, menunjukkan kebolehpercayaan yang tinggi. Analisis data menggunakan statistik deskriptif dan inferens, termasuk min, sisihan piawai, dan Korelasi Spearmen, menunjukkan tahap kesediaan dan pemahaman pelajar yang tinggi dengan korelasi yang signifikan antara kesediaan pelajar dan pemahaman mereka tentang cahaya dan optik dalam konteks NBL. Pelajar mengakui manfaat akademik dan pengalaman NBL, menekankan peranannya dalam memupuk pemikiran kritis dan meningkatkan penglibatan. Kajian ini menyimpulkan bahawa integrasi pembelajaran berasaskan alam semula jadi ke dalam kurikulum fizik dapat meningkatkan pemahaman pelajar terhadap topik yang kompleks seperti cahaya dan optik. Hasil kajian mencadangkan bahawa pendidik masa depan harus mempertimbangkan untuk mengadopsi NBL bagi memperkayakan pendidikan fizik.



TABLE OF CONTENT

	Page
DECLARATION OF ORIGINAL WORK	ii
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
ABSTRAK	v
TABLE OF CONTENT	vi
LIST OF TABLES	xi
LIST OF FIGURES	xiii
LIST OF ABBREVIATIONS	xv
LIST OF APPENDICES	xvi
CHAPTER 1 INTRODUCTION	
1.1 Introduction	1
1.2 Research Background	2
1.3 Rationale of Study	4
1.4 Problem Statement	4
1.5 Research Objectives	6
1.6 Research Questions	7
1.7 Research Hypothesis	7
1.8 Significance of the Research	7
1.8.1 Educators	8
1.8.2 Students	8
1.9 Conceptual Framework	9

1.10 Operational Definitions	10
1.10.1 Light and Optic Nature-Based Education	10
1.10.2 Students' Perceived Understanding	11
1.10.3 Readiness	12
1.11 Limitations	12
1.11.1 Sampling Bias	13
1.11.2 Response Bias	13
1.11.3 Facility Limited by the School	13
1.12 Delimitations	14
1.12.1 Geographical Scope	14
1.12.2 Grade Level	14
1.13 Summary	15

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction	16
2.2 Nature-based learning in education	17
2.3 Learning Theories	21
2.3.1 Theory of Behaviorism	21
2.3.2 Environmental Learning Theory	22
2.3.3 Experiential Learning Theory	24
2.3.4 Theories Related to Nature Based-Learning	26
2.4 Educational Inventory or Questionnaire	27
2.5 Studies of Nature-based Learning in Global Education	29
2.6 Nature-based Learning in Malaysia Education	31

2.7 Research Gap	34
2.8 Summary	35

CHAPTER 3 METHODOLOGY

3.1 Introduction	36
3.2 Research Design	37
3.3 Population and Sample	38
3.4 Instrumentation	39
3.5 Validity	41
3.5.1 Validity Findings of Instruments	43
3.6 Reliability	44
3.7 Pilot Test	45
3.7.1 Reliability Finding of Instruments	46
3.8 Research Data Collection Procedures	47
3.9 Data Analysis	48
3.9.1 Descriptive Statistics	50
3.9.2 Inferential Statistics	51
3.10 Summary	53

CHAPTER 4 ANALYSIS AND RESEARCH FINDINGS

4.1 Introduction	54
4.2 Descriptive Analysis of Respondent's Demographic Information	55
4.2.1 Profile of Respondents	55

4.3 Descriptive Analysis of the Level of Readiness on Implementation of Light and Optics Nature-Based Learning	56
4.3.1 Descriptive Analysis of Academic Benefits Perception	56
4.3.2 Descriptive Analysis of Lifelong Skills Perception	58
4.3.3 Descriptive Analysis of Issues and Challenges Perception	59
4.3.4 Assessment of Normality Test for the Level of Readiness on Implementation of Light and Optics Nature-Based Learning	60
4.3.5 Assessment of the Level of Readiness on Implementation of Light and Optics Nature-Based Learning	76
4.4 Descriptive Analysis of the Perceived Understanding in Physics Topic Light and Optic	77
4.4.1 Descriptive Analysis of Willingness to Relate Nature-Based Learning in Topic	78
4.4.2 Descriptive Analysis of Self Confidence with Respect to Problem Solving	79
4.4.3 Assessment of Normality Test for the Perceived Understanding in Physics Topic Light and Optics	80
4.4.4 Assessment of the Perceived Understanding in Physics Light and Optics	89
4.5 Correlation Between Perceived Understanding in Physics Light and Optics, and Level of Readiness on Implementation of Light and Optics Nature-Based Learning among Form 4 science stream students	91
4.6 Summary	93

CHAPTER 5 DISCUSSION, CONCLUSION, AND RECOMMENDATION

5.1 Introduction	94
5.2 Discussion	95
5.2.1 Students' Perceived Understanding of Light and Optics Towards Nature-Based Learning Experiences	95
5.2.2 Students' Readiness for Nature-Based Learning Experiences Towards Physics Education	96
5.2.3 The Relationship Between Students' Perceived Understanding and Readiness for Nature-Based Learning	97
5.3 Conclusion	98
5.4 Implication of Research	99
5.5 Recommendations for Future Research	100
5.6 Summary	103

REFERENCES	104
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LIST OF TABLES

No. Table		Page
2.1	Theories Related to Light and Optics Nature-Based Learning	26
3.1	Constructs of questions in questionnaire	40
3.2	The Four-point Likert scale of the questionnaire	41
3.3	The Four-point Likert scale of the questionnaire	43
3.4	Findings of expert scores and expert approval percentages	43
3.5	The Cronbach's Alpha value	45
3.6	The result of the Cronbach's Alpha value	46
3.7	Overview of the data analysis for the research questions	50
3.8	The mean score interpretation	51
3.9	The explanations of the correlation coefficient value	52
4.1	Respondents' Profile	55
4.2	Mean and Standard Deviation of items in Academic Benefits Perception construct	57
4.3	Mean and Standard Deviation of items in Lifelong Skills Perception construct	58
4.4	Mean and Standard Deviation of items in Issues and Challenges Perception construct	59
4.5	Skewness and Kurtosis test of the items of readiness on implementation of light and optics nature-based learning. (Aspect 1: Academic Benefits Perception)	61
4.6	Skewness and Kurtosis test of the items of readiness on implementation of light and optics nature-based learning. (Aspect 2: Lifelong Skills Perception)	65



4.7	Skewness and Kurtosis test of the items of readiness on implementation of light and optics nature-based learning. (Aspect 3: Issues and Challenges Perception)	69
4.8	Skewness and Kurtosis test of the constructs of readiness on implementation of light and optics nature-based learning	73
4.9	Skewness and Kurtosis test of the total constructs of readiness on implementation of light and optics nature-based learning	75
4.10	Mean and standard deviation values for constructs of level of readiness on implementation of light and optics nature-based learning	76
4.11	Mean and Standard Deviation of items in Willingness to Relate Nature-Based Learning in Topic construct	78
4.12	Mean and Standard Deviation of items in Self Confidence with Respect to Problem Solving construct	79
4.13	Skewness and Kurtosis test of the items of perceived understanding in physics topic light and optic. (Aspect 1: Willingness to Relate Nature-Based Learning in Topic)	81
4.14	Skewness and Kurtosis test of the items of perceived understanding in physics topic light and optic. (Aspect 2: Self Confidence with Respect to Problem Solving)	84
4.15	Skewness and Kurtosis test of the constructs of perceived understanding in Physics light and optics	87
4.16	Skewness and Kurtosis test of the total constructs of perceived understanding in Physics light and optics	89
4.17	Mean values for constructs of Perceived Understanding in Physics Light and Optics	90
4.18	Result of Spearman Correlation Test	91



LIST OF FIGURES

No. Figure	Page
1.1 Conceptual Framework	9
2.1 Questionnaire Adapted from Ghavifekr, 2020	28
2.2 Questionnaire Adapted from Indriani and Widiastuti	29
3.1 Research Data Collection Procedures	47
4.1 Histogram for Item 1 in Construct 1	62
4.2 Histogram for Item 2 in Construct 1	62
4.3 Histogram for Item 3 in Construct 1	63
4.4 Histogram for Item 4 in Construct 1	63
4.5 Histogram for Item 5 in Construct 1	64
4.6 Histogram for Item 6 in Construct 1	64
4.7 Histogram for Item 1 in Construct 2	66
4.8 Histogram for Item 2 in Construct 2	66
4.9 Histogram for Item 3 in Construct 2	67
4.10 Histogram for Item 4 in Construct 2	67
4.11 Histogram for Item 5 in Construct 2	68
4.12 Histogram for Item 6 in Construct 2	68
4.13 Histogram for Item 1 in Construct 3	70
4.14 Histogram for Item 2 in Construct 3	70
4.15 Histogram for Item 3 in Construct 3	71
4.16 Histogram for Item 4 in Construct 3	71
4.17 Histogram for Item 5 in Construct 3	72
4.18 Histogram of Academic Benefits Perception	74



4.19	Histogram of Lifelong Skills Perception	74
4.20	Histogram of Issues and Challenges Perception	75
4.21	Histogram for Item 1 in Construct 4	82
4.22	Histogram for Item 2 in Construct 4	82
4.23	Histogram for Item 3 in Construct 4	83
4.24	Histogram for Item 4 in Construct 4	83
4.25	Histogram for Item 1 in Construct 5	85
4.26	Histogram for Item 2 in Construct 5	85
4.27	Histogram for Item 3 in Construct 5	86
4.28	Histogram for Item 4 in Construct 5	86
4.29	Histogram for Item 5 in Construct 5	87
4.30	Histogram of Willingness to Relate Nature-Based Learning in Topic	88
4.31	Histogram of Self Confidence with Respect to Problem Solving	88

LIST OF ABBREVIATIONS

eRAS	Educational Research Application System
NBI	Nature-Based Instruction
NBL	Nature-Based Learning
NEECE	Nature-Based Early Childhood Education
NOS	Nature of Science
PRC	Photonics Research Centre
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
UPSI	Universiti Pendidikan Sultan Idris
UV	Ultraviolet
ZnO	Zinc Oxide

LIST OF APPENDICES

No. Appendices

A Questionnaire

B Letter for Expert

C Expert Validation Form

D eRAS Approval

E Consent Form

CHAPTER 1

INTRODUCTION

1.1 Introduction

Physics is a difficult subject for students of secondary schools in Malaysia, especially students in form 4. This is because physics is a branch of science that requires mathematical calculation to derive a theory or law (Darmaji et al., 2019). Among all of the topics covered in the Form 4 syllabus, students found the chapter Light and Optics difficult to learn and understand (Kadir & Yaacov, 2022). At the secondary school level, optics plays a significant role in the physics curriculum (Sebald et al., 2022).



1.2 Research Background

Nature-based learning, which involves experiential teaching in natural settings, is gaining influence in the field of education due to its ability to improve student engagement, achievement in school, and knowledge about the environment. This method emphasises the need of linking students to the natural world in order to encourage curiosity, questioning, and a greater understanding of scientific topics across fields. In addition, the study of physics concepts, which include basic principles such as light and optics, nuclear energy, motion, and forces, is crucial in forming students' scientific literacy and problem-solving abilities. However, standard classroom physics education frequently misses out the learning opportunities provided by outdoor settings, limiting students' exposure to real-world applications of physics ideas.



In the past few years, there has been a growing interest in investigating the relationship between nature-based learning experiences and the effectiveness of studying physics concepts among secondary students. In order to connect schools with communities for the purpose of effectively teaching and studying physics subject, the current global trends in educational reform in physics education place a strong emphasis on community-based learning or out-of-school learning experiences (Tho et al., 2015; Tho et al., 2018). Studies indicate that including outdoor activities into the physics curriculum might improve students' comprehension of physical concepts by offering realistic examples, relevance to the real world, and opportunity for hands-on investigation (Ward et al., 2007). Nature-based learning environments provide lively conditions in which students can observe natural occurrences, conduct experiments, and apply physics principles in real-world scenarios, thereby improving their understanding and memory of essential concepts. Examples include the National Planetarium, the



Light Festival, playground, theme park and Petrosains. These may enable students to investigate the concepts of light and optics in natural settings and see directly how physical events emerge in the world around them.

Despite the potential benefits of nature-based learning in improving physics education, more empirical study is needed to understand the specific mechanisms by which nature-based learning experiences influence students' learning results and attitudes towards physics. This is due to students' perceptions of learning physics influence their understanding of the subject matter (Prosser et al., 1996). Existing research has found a positive correlation between exposure to nature and academic accomplishment, but few studies have specifically looked into the student's perceived understanding of nature-based learning in studying physics concepts.

By surveying students about their experiences with nature-based learning and their views of its impact on their understanding of physics concepts, this study hopes to identify potential correlations and trends that can provide future educational practices and curriculum development efforts. Finally, the goal of this research is to determine the student's perceived understanding of the physics concept from nature-based learning, and to promote the incorporation of outdoor experiences into science education in order to enrich students' learning experiences and improve their ability to solve theoretical problems.

1.3 Rationale of Study

The rationale for this study comes from the methodological creativity and relevance of incorporating nature-based learning experiences into the physics curriculum, which provides students with real-world situations to engage with physics concepts. Nature-based learning provides concrete examples of physics principles in action, which promotes deeper knowledge and connects abstract concepts to real-world applications. Furthermore, studying physics in natural settings encourages environmental awareness and holistic learning experiences that foster curiosity, creativity, and tolerance (Littledyke, 2008). This project is to seek an alternative new teaching and learning methods, nature-based learning awareness, and environmental responsibility in secondary schools by exploring the relationship between nature-based learning and the success of physics education.

1.4 Problem Statement

Environmental education is an out-of-school education program, which significantly improves secondary school students' connection to nature, meeting their expectations for awareness, activities, and experience (Kahyaoğlu et al., 2021). Incorporating outdoor learning experiences into physics education can give students opportunities to apply theoretical concepts in real-world situations, deepen their appreciation for nature, and inspire them to become environmentally responsible citizens. Some students' perceptions about physics learning are related to their personal experiences and interactions with the surrounding environment (Chala et al., 2020). However, there is a lack of actual studies in Malaysia on the impact of nature-based learning on secondary



school physics education. This is because traditional education frequently focuses on theoretical learning in the classroom, which may limit students' opportunity to connect with and apply physics principles in daily life. As a result, students might find it difficult to relate physics concepts and daily life physics in dealing with different types of situations.

Student views and ideas towards physics lessons represent major challenges in Malaysia's secondary school system. According to research from Ogegbo in 2023, students always consider physics as abstract and separate from their daily lives, resulting in an absence of interest and disengagement in the topic. Physics teachers' frequent exposure to real-world experiences is a strong predictor of their student's performance in physics (Ogegbo, 2023). A questionnaire-based study might give valuable insights into what factors are affecting student opinions and interest toward nature-based learning, allowing future educators to design specific strategies to increase student engagement and foster a deeper interest in the subject by collecting feedback on students' perceptions.

Another challenge in environmental physics education is teachers' limited familiarity and ideas with outdoor learning experiences and nature-based education programmes in their teaching practices. Without enough preparation and support, teachers may feel overwhelmed or unwilling to try new teaching methods. Next, many schools lack the funds, facilities, and support systems required to provide meaningful outdoor learning experiences to incorporate into the curriculum, such as field visits, outdoor experiments, and hands-on activities in natural settings (Oberle et al., 2021). Furthermore, Malaysia's current emphasis on standardised tests and exam-oriented





learning may prioritise memorization over a deep understanding of concepts and critical thinking skills (Samad et al., 2008) and survey research is needed to overcome this issue.

Even though the potential benefits of nature-based education, there is a significant research gap in the field regarding the influence of outdoor learning programmes in the Malaysian context, which have a limited impact on students' critical thinking, problem-solving skills, scientific attitudes, and motivation, highlighting the need for additional research. Based on these problems, a survey study is urgently needed to fill the gaps and challenges in Malaysian nature-based physics education to overview the current situation.



1.5 Research Objectives

- i. To determine students' perceived understanding of light and optics towards nature-based learning experiences.
- ii. To determine the students' readiness of nature-based learning experiences towards physics education.
- iii. To investigate the relationship between students' perceived understanding and students' readiness according to nature-based learning experiences by studying physics concepts among secondary school Form 4 physics students.



1.6 Research Questions

- i. What are the students' perceived understanding of light and optics towards nature-based learning experiences?
- ii. What is the students' readiness of nature-based learning experiences towards physics education?
- iii. What is the relationship between students' perceived understanding and students' readiness according to nature-based learning experiences by studying physics concepts among secondary school Form 4 physics students?

1.7 Research Hypothesis

Null Hypothesis (Ho): There is no significant relationship between students perceived understanding and students' attitudes according to nature-based learning experiences by studying physics concepts among secondary school students.

1.8 Significance of the Research

This study's findings have important implications for educators and students in the field of physics education, underlining the need for improved guidance and discussion in research publications (Ioannidis, 2007). For example, the study's findings may help to shape research-based strategies for incorporating nature-based learning into physics teaching, thereby improving students' understanding and engagement with the topic.



1.8.1 Educators

This study benefits physics teachers and educators by emphasising the potential of nature-based learning experiences to help in students' comprehension of physics concepts. Understanding the positive impact of nature-based learning on students' learning outcomes and attitudes towards physics education can inspire teachers to incorporate more outdoor experiences, hands-on activities, and inquiry-based learning opportunities into their physics curriculum, resulting in an interactive and engaging learning environment that promotes scientific literacy and creativity.

1.8.2 Students



The topic light and optics is chosen for this study is because this topic is said as a confusing and hard topic for students. Thus, this study gives students a greater understanding of the advantages of nature-based learning experiences in their ability of learning physics concepts. By participating in nature-based learning activities, students can gain a more comprehensive grasp of physics principles and their real-world applications. This study encourages students to take responsibility of their learning and to use the natural world as a laboratory for scientific inquiry, developing curiosity, creativity, and a lifetime enjoyment of learning.



1.9 Conceptual Framework

A conceptual framework is a written or graphic description of how variables are intended to interact. It also allows researchers to readily evaluate research design and instruments (Hughes et al., 2019). The conceptual framework also serves as a road map for the study, directing research design, data gathering, and analysis. Figure 1.1 shows the researcher's conceptual framework for relating the independent and dependent variables.

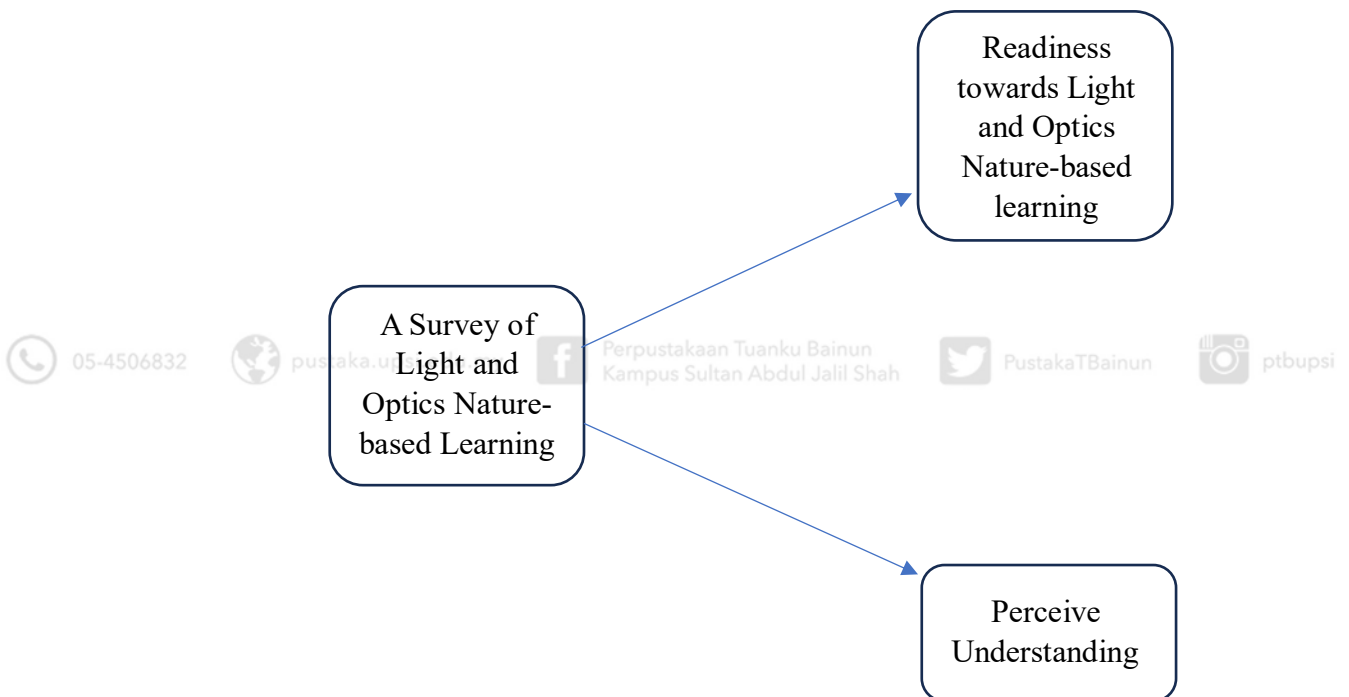


Figure 1.1. Conceptual Framework Relating Independent and Dependent Variables

This illustrates the relationships between key variables, which a survey of light and optics nature-based learning act as the independent variables, while the readiness towards light and optics nature-based learning and perceive understanding of students as the dependent variables.

The framework's central idea is that nature-based learning experiences act as catalysts for obtaining students' grasp of physics ideas and fostering good attitudes towards science education.

1.10 Operational Definitions

In this study, there were a few concepts that needed to be operationally defined in order to explain and obtain the information required by the researcher. The operational definition is intended to prevent confusion and misinterpretation in the study.

1.10.1 Light and Optic Nature-Based Education

In nature-based education, the nature-based learning experiences include outdoor field trips, hands-on experiments in natural settings, and ecological observations or discoveries. High-quality outdoor learning experiences include effective collaboration between guide and teacher, active learning, psychomotor activity, and a sense of freedom for student exploration and interaction, all of which may enable students to engage with the natural world and apply scientific concepts in authentic contexts (Tal et al., 2014). In latest Curriculum and Content Standards Document (DSKP) of subject Physics, the topic Light and Optics is one of the difficult topics in Form 4 syllabus, which covers the fundamental principles of light, including reflection, refraction, and dispersion. Students learn about how light behaves when it interacts with different surfaces and mediums, such as mirrors, lenses, and prisms. In this study, the light and optic can be connected with the nature-based learning by exploring the reflection and

refraction happens in the nature and surrounding through showing videos to the students of prior nature-based learning from others. This briefing session is given before the study starts and no data collection occurred.

1.10.2 Students' Perceived Understanding

Students' perceived understanding is defined as the student's assessment of their success or failure when attempting to communicate with another person (Schrodt et al., 2006). In this study, the constructs of student's perceived understanding including Academic Benefits Perception, Lifelong Skills Perception, Issues and Challenges Perception. Therefore, a questionnaire is adapted from Ghavifekr (2020). Additionally, the constructs of students' perceived understanding in their Willingness to Relate Nature-Based Learning in Light and Optics Topic, and Self Confidence with Respect to Problem Solving are adapted from Indriani and Widiastuti (2024).

Physics education outcomes include the expected educational goals and achievements related with the study of physics concepts. These goals could include students' understanding of physics principles, problem-solving abilities, critical thinking skills, and attitudes towards physics education. The perceived understanding of student can be measured through the survey with the factors of Willingness to Relate Nature-Based Learning in Light and Optics Topic, and Self Confidence with Respect to Problem Solving.

1.10.3 Readiness

Students' readiness towards light and optic nature-based learning refers to the level whereby students are prepared and willing to participate in educational activities that include grasping the principles of light and optics through firsthand experience with natural environments. Students' readiness is also referring to the extent to which they possess the skills, knowledge, and disposition necessary to succeed academically and socially in higher education practices (Moleta et al., 2023).

This attitude is measured using surveys or questionnaires that assess factors such as Academic Benefits Perception, Lifelong Skills Perception, Issues and Challenges Perception. By understanding students' attitudes towards physics learning, educators can determine a better teaching strategy to enhance student engagement and achievement in the subject.

1.11 Limitations

Limitations are factors or constraints that may affect the validity, reliability, or generalizability of a study's results. These may include logistical issues, sample size restrictions, or methodological constraints such as violence measurement insensitivity, cross-sectional data, and data missing spatially contiguity (Johnson et al., 2019).

1.11.1 Sampling Bias

The findings of the research may be limited by sampling bias if the participants are not common of Malaysia's wider population of secondary school students. For example, the sample is primarily made up of students from rural areas or specific socioeconomic backgrounds, the accuracy of the results might be affected.

1.11.2 Response Bias

Response bias, which occurs when participants submit incorrect or socially desirable responses, can have an impact on the dependability of survey results. Factors such as social desirability bias, acquiescence bias, and response fatigue can all influence participants' responses, resulting in biased or misleading data.

1.11.3 Facility limited by the school

Schools often face limitations in facilities, such as lacking access to specialised facilities like planetariums, limiting students' exposure to real-world applications of physics concepts. In addition, some schools may face the problem of funds lacking to having nature-based learning for the students. These facility limitations disproportionately affect schools serving in access to quality education.

1.12 Delimitations

The research scope specifies the study's boundaries and parameters, such as its particular focus, the population, and geographic location. The research scope in this study focusses on secondary school students from Malaysia's urban areas who have participated in nature-based learning activities.

1.12.1 Geographical Scope

The research is restricted to a single location or district in Malaysia, for example, district Sarikei in the Sarawak state, in order to concentrate on local settings and minimise the logistics of gathering data.

1.12.2 Grade Level

The study is limited to specific grade levels within secondary schools, where only upper form of secondary school students, specially Form 4 students in Sarikei, Sarawak are chosen to participate in this study. This population of students are chosen in order to target a homogeneous community of children with similar academic backgrounds and developmental behaviours. However, the topic light and optics is chosen for this study is because this topic is already learned by the Form 4 students and the topic is said as a confusing and hard topic for them.

1.13 Summary

In conclusion, this research plays an importance role in physics education. This is because this research investigates the correlation between light and optics nature-based learning and the secondary school's physics students' perceived understanding in Sarikei, Sarawak. Thus, a questionnaire survey is conducted to determine the students' perceived understanding of light and optics nature-based learning. The significance of the research lies in its potential to determine student's perception against the light and optics nature-based learning towards their perceived understanding, and thus suggest an alternative teaching strategies to the future teachers.