Research Report

Sub - Research Report 3

A CONCEPTUAL MODEL OF BI-DIMENTIONAL DEVELOPMENT FOR HAPPINESS ACCESS BY BIOFEEDBACK PROCESS

Under Research Plan

HOLISTIC MENTAL AND INTELLECTUAL DEVELOPMENT WITH THE BIOFEEDBACK PROCESS

BY
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Venerable Phramaha Nantakorn Piyabhani, Dr.
Dr. Orachorn Kraichakr, and
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Research Project Funded by
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Research Title: A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process
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ABSTRACT

This is a qualitative research consisting of three objectives, namely: - (1) to explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH); (2) to examine the theory of biofeedback; and (3) to propose a conceptual model of Bi-Dimensional development for happiness access by biofeedback process. The data collection and in-depth interviews were carried out with 8 key-informants from 6 countries. They are monks and Buddhist scholarly representatives with the IOC examined by 3 experts.

The findings show Buddhism suggests the access of superior happiness by dealing with the *dukkha-sukha* dichotomy of dualism; while the practice of GNH constructed by the four pillars with the middle path, contentment and social engagement. The Biofeedback skillfully employed the instruments, EMG, EEG, etc. into treatments. When they are integrated with the Buddhist meditation, a practitioner can entrain the assessment of happiness in a tangible way. As for the Model created suggests the Bi-Dimensional development for happiness access. First, MENTAL Dimension to access the fivefold happiness in concentration, namely: - Gladdening (*pāmojja*), Happiness (*pīti*), Tranquility (*passaddhi*), Bliss (*sukha*), and Concentration (*samādhi*). The biofeedback means can be utilized for happiness measurement from the mind-body phenomena in the practice. Second, WISDOM Dimension for perpetual happiness access is Nibbāna, the supreme happiness.

ชื่อรายงานการวิจัย: แบบจำลองแนวคิดในการพัฒนาแบบทวิมิติเพื่อการเข้าถึงความสุขด้วยกระบวนการไบโอฟีดแบค (biofeedback)
ผู้วิจัย: ผศ.ดร. สานุ มหัทธนาดุลย์, พระมหานันทกรณ์ ปิยภาณี, ดร., ดร. อรชร ไกรจักร์ และ ดร. สริตา มหัทธนาดุลย์
ส่วนงาน: วิทยาลัยพุทธศาสตร์นานาชาติ มหาวิทยาลัยมหาจุฬาลงกรณราชวิทยาลัย
ปีงบประมาณ: 2560
ทุนอุดหนุนการวิจัย: มหาวิทยาลัยมหาจุฬาลงกรณราชวิทยาลัย

บทคัดย่อ

การวิจัยครั้งนี้เป็นการวิจัยเชิงคุณภาพประกอบด้วยวัตถุประสงค์ 3 ประการคือ (1) เพื่อสำรวจแนวคิดเรื่องการเข้าถึงความสุขตามหลักพระพุทธศาสนาและแนวคิดความสุขมวลรวมประชาชาติ (GNH), (2) เพื่อศึกษาทฤษฎีไบโอฟีดแบ็ค (biofeedback) และ (3) เพื่อนำเสนอแบบจำลองแนวคิดในการพัฒนาแบบทวิมิติเพื่อการเข้าถึงความสุขด้วยกระบวนการไบโอฟีดแบค ในการเก็บข้อมูลได้ดำเนินการเก็บข้อมูลเชิงเอกสารพร้อมทั้งจากการสัมภาษณ์เชิงลึกกับผู้ให้ข้อมูล 8 ท่านจาก 6 ประเทศที่เป็นพระภิกษุและนักวิชาการชาวพุทธผู้ที่มีความรู้ทั้งทางพระพุทธศาสนาและวิทยาศาสตร์ ตรวจสอบดัชนีความสอดคล้องระหว่างข้อคำถามและวัตถุประสงค์ (IOC) โดยผู้เชี่ยวชาญจำนวน 3 ท่าน

ผลวิจัยแสดงให้เห็นว่าพระพุทธศาสนาให้ความสำคัญกับ “การเข้าถึงความสุขเหนือความสุข” นั่นคือการเข้าถึงความสุขที่เหนือกว่าโดยการจัดการกับภาวะของทุกข์และสุข ในขณะที่ข้อปฏิบัติของความสุขมวลรวมประชาชาติเน้นทางสายกลาง วิถีแห่งความสันโดษ และการมีส่วนร่วมทางสังคม ส่วนกระบวนการไบโอฟีดแบคใช้เครื่องมือตรวจวัดที่หลากหลาย 7 ประเภท มี การตรวจคลื่นสมอง (EEG) และการตรวจเส้นประสาทและกล้ามเนื้อด้วยไฟฟ้า (EMG) เป็นต้น เมื่อกระบวนการดังกล่าวถูกนำมาประยุกต์ใช้กับการฝึกกรรมฐานตามแนวพุทธแล้ว จะทำให้ผู้ปฏิบัติธรรมสามารถประเมินความสุขในสมาธิของตนในรูปแบบที่สามารถจับต้องได้อย่างเป็นรูปธรรม สำหรับตัวแบบจำลองที่สร้างขึ้นนั้นแสดงให้เห็นถึงการพัฒนาแบบทวิมิติเพื่อการเข้าถึงความสุข ประการแรกคือ (1) มิติทางจิตใจ หมายถึงการพัฒนาจิตใจเพื่อเข้าถึงความสุขในสมาธิ 5 อย่าง ได้แก่ ปราโมทย์, ปีติ, ปัสสัทธิ, สุข และ สมาธิ เครื่องมือของไบโอฟีดแบคสามารถนำมาใช้ประโยชน์ได้อย่างกลมกลืนกับการฝึกสมาธิและความสุขที่เกิดขึ้นสามารถวัดได้จากปรากฏการณ์ของทั้งร่างกายและจิตใจ ประการที่สองคือ (2) มิติทางปัญญา หมายถึงการพัฒนาปัญญาเพื่อการเข้าถึงพระนิพพานความสุขสูงสุดแห่งมวลมนุษยชาติ

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Asst. Prof. Dr. Sanu Mahatthanadull,

Head of the research project

March 1, 2020

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List of Abbreviations

A) Abbreviations of Scriptures

In this research paper, the researcher has referred various sources of data both primary and secondary from Pali Canon (Tipiṭaka), Commentaries (Atthakathās), Sub-commentaries (Tīkas), Sub Sub-commentaries (Anutīkas), Pakaraṇa Visesas, and so on. The system of abbreviations will be systematized as follows:

The Pali Canon, using the Pali texts series edited in Roman by the Pali Text Society (PTS). Its forms are to be quoted firstly an abbreviation of the scripture, then followed by volume and page number (s) respectively, e.g., D.II.81. refers to Dīghanikāya of the Suttanta Piṭaka**,** Mahā-vagga, page number 81. In case of scriptures with only one book, the volume will be omitted, for instances, Vbh.86. refers to Vibhaṅga of the Abhidhamma Piṭaka, page number 86.

A. : Aṅguttaranikāya (5 vols.)

AA. : Aṅguttaranikāya Aṭṭhakathā (Manorathapūraṇī)

Bv. : Buddhavaṃsa (Khuddakanikāya)

Comp. : Compendium of Philosophy (Abhidhammatthasaṅgaha)

D. : Dīghanikāya (3 vols.)

DA. : Dīghanikāya Aṭṭhakathā (Sumaṅgalavilāsinī)

Dh. : Dhammapada (Khuddakanikāya)

DhA. : Dhammapada Aṭṭhakathā

Dhs. : Dhammasaṅganī (Abhidhamma)

DhsA. : Dhammasaṅganī Aṭṭhakathā (Aṭṭhasālinī)

It. : Itivuttaka (Khuddakanikāya)

J. : Jātaka

Kvu. : Kathāvatthu (Abhidhamma)

M. : Majjhimanikāya (3 vols.)
Miln. : Milindapañhā
Mvu. : Mahāvastu
Nett. : Nettipakaraṇa
Ps. : Paṭisambhidāmagga (Khuddakanikāya) (2 vols.)
Pug. : Puggalapaññatti (Abhidhamma)
Pv. : Petavatthu (Khuddakanikāya)
PvA. : Petavatthu Aṭṭhakathā (Paramatthadīpanī IV)
S. : Saṃyuttanikāya (5 vols.)
SA. : Saṃyuttanikāya Aṭṭhakathā (Sāratthapakāsinī)
Sn. : Suttanipāta (Khuddakanikāya)
Vbh. : Vibhaṅga (Abhidhamma)
VbhA. : Vibhaṅga Aṭṭhakathā (Sammohavinodanī)
Vin. : Vinaya Piṭaka (5 vols.)
Vism. : Visuddhimagga

B) List of Common Scholarly Abbreviations used in the Research

Single	Plural	Full Word/Meaning
ANS		autonomic nervous system
Assoc. Prof.		associate professor
Asst. Prof.		assistant professor
BB		brachii
BPV		blood pulse variability
BSD		Buddhist sustainable development
B.A.		Bachelor of Arts
B.E.		Buddhist Era

CAM		complementary and alternative medicine
CC		chronic constipation
CD		cervical dystonia
C.E.		Common Era or Current Era
DD		dyssynergic defecation
EDA		electrodermal activities
EDG		electrodermograph
EDR		electro-dermal response
ed.	eds.	editor (s), edited by
EEG		electroencephalography
EGNH		educating for Gross National Happiness
Em.		Emeritus
EMG		electromyography
EPSPs		excitatory postsynaptic potentials
et al.		et alii/ and others
etc.		et cetera/ and others
e.g.		example gratia, example
fig.	figs.	figure (s)
fMRI		functional magnetic resonance imaging
GNH		Gross National Happiness
GSR		galvanic skin response
HRV		heart rate variability
Hz		hertz
ibid.		ibiden/ in the same page, i.e., the same source which has been cited in the immediately preceding note

IPSPs		inhibitory postsynaptic potentials
i.e.		id est, that is to say
LEA		life-energy analysis
MBCT		Mindfulness Based Cognitive Therapy
MCU		Mahachulalongkornrajavidyalaya University
ML		machine learning
M.A.		Master of Arts
no.	nos.	number (s)
NRCT		National Research Council of Thailand
n.d.		no date (of publication)
n.p.		no page (of publication)
op.cit		opera citato/ as referred
PD		idiopathic
PET		positron emission tomography
PGR		psychogalvanic reflex or response
Ph.D.		Doctor of Philosophy
PNG		pneumography
PPG		photoplethysmographic
Prof.		professor
PTS		Pali Text Society
p.	pp.	page (s)
RESP		respiratory Sensors
SC		skin conductance
sEMG		surface electromyography
TMS		transcranial magnetic stimulation
tr.	trs.	Translate (s)

Ven.		venerable
vol.	vols.	volume (s)

Chapter I

Introduction

1.1 Background and Significance of the Problems

The current situations in the radically changing world, health prevention and promotion thus become a matter that society should pay attention to. Sound health or well-being (*sukkha bhāva*) in this context is a word that represents the happiness, both physical and mental. The said two words must always come together and have a mutual relationship. Sound physical body would result in sound mind; on the other hand, sound mind would result to sound physical body. That is because of the illuminating mind would be in the perfect physical body. Thus the saying that physical and mental health is equally important is because the body and mind rely on each other and must live together. Mind cannot be good while its physical body is still in physical suffering (*dukkha*). The saying "A sound mind in a sound body"[1] demonstrates the close relationship between physical competency and mental quality in equilibrating the holistic life. That is an ability of a person to realize the truth of life among the two sides of the same coin.

In addition to the above, the Dhammapada, The Word of the Doctrine, said in the Happiness Section (*sukhavagg*a):

arogyaparamā lābhā, santuṭṭhiparamaṃ dhanaṃ,

Vissāsaparamā ñātī, nibbānaṃ paramaṃ sukham.[2]

They can be translated as "Health is the best possession; contentment is the best wealth; confidence is the best relative; *nibbāna* is

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[1] A famous quotation by the pre-Socratic Greek philosopher, Thales of Miletus , 624 - 546 BC.

[2] Dh. 204.

the best happiness."[3] It is true to say what the Buddha said to King Pasendhi Kosala in the Kingdom of Kosala shows that Good health is superior to any fortune or possession and is the top desire of everyone. The healthy for him not only is the fortune for him but will be true happiness. With this good health, we are able to contribute to any occupation and with the understanding of this fact; we therefore need to knowingly have a right view towards the relationship of both physical body and mind.

In a smaller scale, the happiness of individuals is only limited within themselves. But in a larger scale, such happiness will extend to the society where every social member makes a quality co-existence. As an example of the Bhutan country where has been named the people of the residents who are most happy in the world. With the country's righteousness, the foundation of Bhutan, spirituality and compassion have been integrated with governance. Besides, this integration has occurred at both the personal and the institutional level. The Gross National Happiness (GNH) is not only a national multidimensional development model for Bhutan but also a defining component of the image of the Bhutanese state itself, portraying an autonomous and coherent entity leading the pursuit of national happiness in partnership with Bhutanese society.[4] Such society depicts a place where the stream of happiness among the coexistence of every social member flows constantly and uninterruptedly.

People, who are living in society as a sub-member of a large society, may not be able to avoid interactions with the environment as a whole. As Buddhism has mentioned the principle of holistic life development is the mechanism for the development of the physical body, behavior, mind and human intelligence. They are the 4 aspects of life-developers which cover the whole body of life's physical, moral, mental, and wisdom well-being. These 4 areas are a necessary mechanism to

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[3] K.R. Norman (tr.), **The Word of the Doctrine (Dhammapada)**, (Oxford: PTS, 1997), p. 30.

[4] Kent Schroeder, **Politics of Gross National Happiness: Governance and Development in Bhutan**, (Cham, Switzerland: Springer Nature, 2018), p. 21.

drive human self-development ability for both physical and mental happiness in which Buddhism emphasizes 4 types of tools, respectively, to manipulate the health of the physical body (*kāya bhāvanā*); to observe the precepts with absolute vigilance, not to let one's actions cause trouble to the other people in the society (*sīla bhāvanā*); to concentrate and focus continuously on every thought of one's self with a goal aimed at contemplation (*citta bhāvanā*); And finally the last piece of tools is the development of wisdom as to spiritually augment one's wisdom according to the Buddhist way (*paññā bhāvanā*). The aim is to see things as they really are, not in a distorted way. It is based on the Four Foundations of Mindfulness. Implied by this, it is the process that leads to spiritual development and leads to access to the happiness of individuals in society, which means emphasizing the sustainable development of true human potential.

On the contrary, biofeedback is a process that enables an individual to learn how to change physiological activity for the purposes of improving health or performance. Precise instruments measure physiological activity such as brainwaves, heart function, breathing, muscle activity, and skin temperature. These instruments rapidly and accurately "feed-back" information to the user. The presentation of this information, often in conjunction with changes in thinking, emotions, and behavior, may support desired physiological changes. Over time, these changes can endure without continued use of an instrument.[5] Due to the fact that human beings are capable of developing their mind and wisdom which is closely related to the innate physical body, it is therefore shows us the significant relationship between corporeality and mentality. However, numbers of research works indicated such relationship. For instance, the finding of the work of Catherine Andrea Prato, showed statistically significant changes in respiratory rates and skin temperatures during the diaphragmatic breathing session; changes in respiratory rates and peripheral skin temperatures were statistically significant during the progressive muscle relaxation training session, and statistically significant

[5] MJ Dvorznak, RA Cooper, TJ O'Connor, and ML Boninger, "Braking Study", **Reh ab R&D Prog Rpts** (1997): 294.

changes in respiratory rates, peripheral skin temperatures, and pulse rates were found during the autogenic training sessions.[6] These are the forms of holistic development between body and mind of human beings in some way in which the form should be further studied in particular.

The research team thus suggests that the research topic "A Conceptual Model of Bi-Dimensional development for Happiness Access by Biofeedback Process" is an in-depth study of the concept of Bi-Dimensional human development mechanisms in Buddhism. This is an urgent need to study the said matter in order to deepen our understanding towards the underlined concept of biofeedback process, the Bi-Dimensional development and the happiness access. They can be considered as helping state to prevent and solve public health problems that are urgent. Besides, it is a sustainable strengthening of the public health for the country's population in which the findings of this research will be a database for related parties to import into the policy and into action plans causing the prevention and solving of sustainable health problems along the Buddhist path. And finally it can be able to access to the happiness, the true need of mankind.

1.2 Objectives of the Research

1.2.1 To explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH).

1.2.2 To examine the theory of biofeedback.

1.2.3 To propose a conceptual model of bi-dimensional development for happiness access by biofeedback process.

1.3 Statement of the Problems Desired to Know

The research starts with delineating the three researchable problems to be discussed. They are:

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[6] Catherine Andrea Prato**, "**Biofeedback assisted relaxation training program to decrease test anxiety in nursing students", **Doctor of Philosophy (Nursing) Dissertation**, (The Graduate College: University of Nevada, Las Vegas, 2009), p. iv.

1.3.1 What are the concept of access of happiness according to Buddhist principles and the concept of Gross National Happiness (GNH)?

1.3.2 What is the theory of biofeedback described?

1.3.2 How should the feature of the Conceptual model of bi-dimensional development for happiness access by biofeedback process be characterized?

1.4 Scope of the Research

Scope of the research is stipulated into the following three dimensions, namely:-1.Scope of Sources of Data; 2. Scope of Content; and 3. Scope of Populations, Samples and Key Informants. Details are as follows:

1.4.1 Scope of Sources of Data

The researcher focuses on studying the concept of access of happiness according to Buddhist principles by exploring deeply into the primary source of Pāli Canon (*Tipiṭaka*), Commentaries (*atthakathā*), Sub-commentaries (*tīkās*), Sub Sub-commentatires (*anutīkās*), Special Texts (*pakaraṇa-visesa*), etc. respectively. By using the Pāli Text Society's Pāli version and English translation series as well as the secondary source of Buddhist textbooks, research works, Doctor of Philosophy dissertations, journals, books, newspapers, including online sources, etc., among Pāli, Thai and English languages. In addition to those abovementioned sources, the in-depth interviews are also conducted with eight key-informants from six countries around the world. The details regarding the interview have been clearly detailed in the topic "Scope of Populations, Samples and Key Informants" of this Chapter I.

1.4.2 Scope of Content

In this research, the research team has established a framework based on the respective objectives for the exploration of the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH). Then the theory of biofeedback will be examined under the framework of the integration of knowledge between Buddhism and the biofeedback theory both of psychology and therapeutic therapy. It is in order to propose a conceptual model of bi-dimensional

development for happiness access by biofeedback process. Therefore, the research focuses on the following four areas.[7]

a. Concept of Happiness Access according to Buddhist Principles

A preliminary step of study on the underlined concept of happiness access in order to achieve the basic knowledge about what happiness is and how can one access to such state. The study focuses briefly on the Buddhist teachings on the two following issues, namely: - (1) Definitions and Types of Happiness, and (2) Methods of Happiness Access.

b. Concept of Gross National Happiness (GNH)

Exploring the concept of Gross National Happiness (GNH) are divided into two major elements, namely: - (1) History of GNH, and (2) Practices of GNH.

c. Theory of Biofeedback.

Examining the theory of Biofeedback, the research particularly focuses on (1) the Biofeedback in Medical Science, and (2) Biofeedback in Others Fields.

d. A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process.

In this area the research, a conceptual model is to be proposed by integrating all of the abovementioned body of knowledge as a whole. The presentation is as follow:- (1) SWOT Analysis among Buddhist Principles, GNH and Biofeedback Theory, and (2) A Conceptual Model Presentation.

1.4.3 Scope of Populations, Samples and Key Informants

[7] The first three areas are to be discussed in the Chapter II where general literatures and numbers of research work related to the objective number one are reviewed. Whilst the fourth area is to be discussed in the Chapter IV where the research findings are analyzed by using information from both primary and secondary texts together with some key information obtained from the key-informants.

Due this is the qualitative research by analyzing of data from documents and field studies relating to the presenting of A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process. Therefore the area, population and samples are focused on both local and international organizations with working processes that focus on studying and learning Buddhist happiness access as well as the process of biofeedback consisting in the human's bodies. The purposive random sampling technique was used based on the significance of the studies.

The population appeared in this research concerns with groups of eight key-informants who are monks and Buddhist scholars with knowledge of Buddhism and sciences, and who have expertise in interdisciplinary integration into education and way of life sciences. There are totally six countries among the domestic and international organizations around the world, namely: - (1) Thailand, (2) Bhutan, (3) United Kingdom, (4) United States, (5) India, and (6) Sri Lanka. Name lists are given as follows:

1. Most Venerable Professor Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand;

2. Venerable Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan;

3. Venerable Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand;

4. Emeritus Professor Dr. Peter Harvey, University of Sunderland, United Kingdom;

5. Professor Dr. Phillip D. Stanley, Naropa University, Colorado, United States;

6. Professor Dr. Geeta Manaktala, Panjab University, Chandigarh, India;

7. Emeritus Professor Dr. Pahalawattage Don Premasiri, University of Peradeniya, Sri Lanka;

8. Dr. Supriya Rai, Director, K. J. Somaiya Centre for Buddhist Studies, India.

However, the in-depth interview's forms were examined in terms of the Item-Objective Congruence (IOC) by the 3 experts, namely:-

1. Most Venerable Associate Professor Dr. Phra Methavinairos, Mahamakut Buddhist University, Thailand;

2. Associate Professor Dr. Praves Intongpan, Department of Philosophy and Religion, Faculty of Humanities, Kasetsart University, Thailand; and

3. Associate Professor Dr. Amnaj Buasiri, Committee of Education Council, Ministry of Education, Thailand.

1.5 Definition of the Terms Used in the Research

The research contains technical terminologies related to the study both from Modern Sciences and Buddhism. Thus, in order to avoid some misunderstanding among them and make the most benefit to the study, the definitions are given as follows:

1.5.1 Happiness refers to happiness in the concentration which is a type of happiness that one experiences in the concentration practice, namely: - Gladdening (*pāmojja*), Happiness (*pīti*), Tranquility (*passaddhi*), Bliss (*sukha*), and Concentration (*samādhi*). As well as happiness based on the theory of Gross National Happiness (GNH).

1.5.2 Happiness Access refers to the attainment of happiness in concentration practice (*dhammasamādhi*) according to Theravāda Buddhist Principle. In such practice, the fivefold happiness existed, namely: *pāmojja*, *pīti*, *passaddhi*, *sukha*, and *samādhi*. As well as happiness based on the theory of Gross National Happiness (GNH).

1.5.3 The Concept of Happiness Access refers to the concept of happiness access from both Theravāda Buddhist principles and Vajrayāna GNH.

1.5.4 Buddhist Principles mean the Theravāda Buddhist teachings relating to the concept of happiness access, which covering (1) definitions, (2) types of happiness, and (3) the practices of happiness

access in which its evidences are based on the Theravāda Tipiṭaka or the Pāli Canon.

1.5.5 The Concept of Gross National Happiness (GNH) means a Vajrayāna Buddhist philosophy on the gross happiness and well-being of a population of Bhutanese. It covers the two main concepts, namely: - (1) Origin and development of GNH, and (2) Practices of GNH.

1.5.6 The Theory of Biofeedback refers to the biofeedback theory as appeared in medical science and others fields, such as biofeedback therapy. It includes the biofeedback's ends, ways and means.

1.5.7 A Conceptual Model refers to a model which is created as an integrative method by integrating together between the concept of happiness in Theravāda, Vajrayāna Buddhism and the Theory of Biofeedback. The Model particularly represents bi-dimensional development, namely: MENTAL and WISDOM development in order for happiness access by biofeedback process.

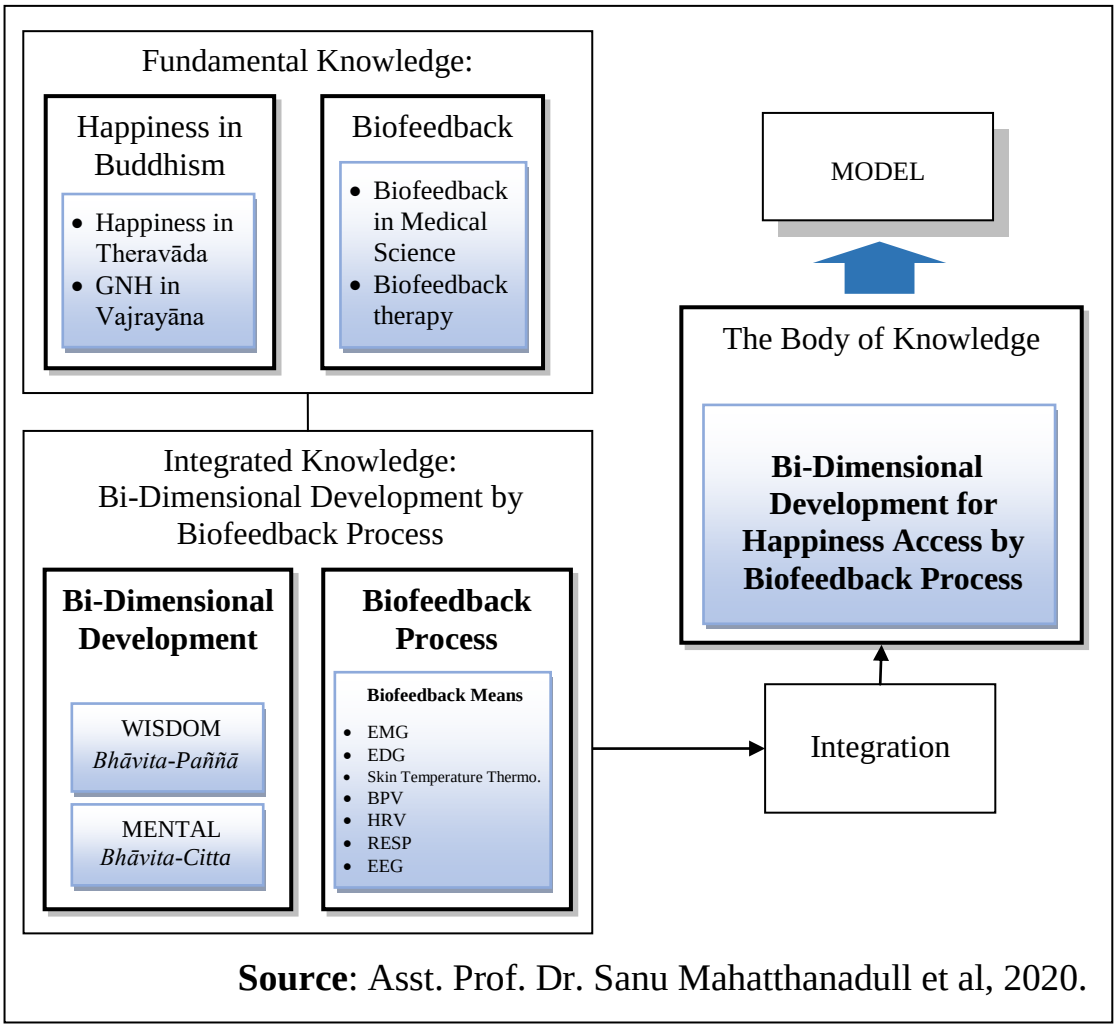
1.5.8 Bi-Dimensional Development refers to the twofold development (*bhāvanā*) based on the Theravāda Buddhism. They are:- 1) MENTAL development (*citta-bhāvanā*) and 2) WISDOM development (*paññā-bhāvanā*). The original principle that appeared in the Pāli Canon was *bhāvita-citta, and bhāvita-paññā* respectively. The happiness can thus be accessed merely by means of this kind of bi-dimensional development.

1.5.9 Biofeedback Process refers to the biofeedback theory studying on the process of significant interaction between the physiological body and mind of human beings by using the 7 biofeedback means, EMG, EDG, Skin Temperature Thermography, etc. It can be utilized with Buddhist meditation for development of happiness access of practitioners as suggested in the presented Model.

1.6 Conceptual Framework

The conceptual framework of the research exhibits the significant research framework in terms of selected concepts and principles. It may be shown as follows:

Chart 1.1: Conceptual Framework



Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

1.7 Advantages Expected to Obtain from the Research

This research paper contributes to the advantages as follows:

1.7.1 Acquisition of Body of knowledge about the concept of access of happiness according to Buddhist principles and the concept of Gross National Happiness (GNH), as well as the theory of biofeedback.

1.7.2 Sharpening of knowledge and application of bi-dimensional development in order for happiness access by the biofeedback process.

1.7.3 The Buddhist psychological biofeedback and interdisciplinary applied groups can integrate the research findings to the existing therapeutic system in a more holistic manner.

1.7.4 Mahachulalongkornrajavidyalaya University (MCU); Buddhist Research Institute of MCU; International Buddhist Studies College (IBSC) of MCU; Tango Dorden Tashithang Buddhist University, Bhutan; Mahapanya Vidayalai (MPV), Thailand; University of Sunderland in United Kingdom; Naropa University in USA; Panjab University, India; University of Peradeniya, Sri Lanka; K. J. Somaiya Centre for Buddhist Studies in India, and other related organizations can apply the research findings in Buddhist teachings, modern sciences, Buddhist psychology and biofeedback psychology. There may be a comparison of psychological knowledge in a variety of dimensions.

1.7.5 There is a search for knowledge and holistic well-beings based on Buddhist biofeedback psychology.

Chapter II

Concepts, Theories and Related Research Works

In this chapter, based on the respective objectives of the research, the research team has reviewed all of the literatures and research works in which they are related to this particular study. Therefore, the preliminary step is collective reviewing of the significant sources pertaining to the concept of happiness access as Theravāda Buddhist texts have been described. The concept of Gross National Happiness (GNH) is then also reviewed. Besides, due to the crucial issues of the study also involve with theories about biofeedback, it is therefore included in this chapter as well. At last, numbers of sources about the model related to the study that has already been presented will be collected here. The abovementioned topics are to be presented respectively in the following manners: - 1) Concept of Happiness Access according to Buddhist Principles and Concept of Gross National Happiness (GNH), 2) Theories of Biofeedback, 3) A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process, and 4) Related Research Works.

2.1 Concept of Happiness Access according to Buddhist Principles and Concept of Gross National Happiness (GNH)

According to Theravāda Buddhist principles, the access of happiness portrays an ability to achieve to *sukha* , the universal bliss. While Gross National Happiness, or GNH, is a holistic and sustainable approach for development of Bhutan, the world's happiest country in the world. In this topic, the presentation is as follows: - (1) Concept of Happiness Access according to Buddhist Principles, and (2) Concept of Gross National Happiness (GNH).

2.1.1 Concept of Happiness Access according to Buddhist Principles

1. Phramaha Hansa Dhammahaso[1] has discussed about types of happiness in a book named "Buddhism and Modern Sciences" It can be inferred that the life with good health according to Buddhism must associate with both kinds of happiness:- (1) Physical happiness (*kāyika-sukha*) is the happiness that results from physical components can perform the normal function, not malfunction, such as seeing beautiful pictures; hearing pleasurable sounds; smelling odorous; tasting delicious taste; and touching tangible soft. They are called the contact from sensual pleasures (*Kāmaguṇa*), (ear, nose, nose, tongue, body), (2) Mental happiness (*cetasika-sukha*) means that the mind is delighted, cheerful, not bothered by the power of defilement in mental doors: greed, hatred and delusion, the cause of sorrow and grief. The mental happiness is the state of mind that is usually bright, cheerful, not dull with the mind-objects that comes to mind.

2. Padmasiri de Silva[2] has mentioned about the opposite side of happiness in a book named "The Psychology of Emotions and Humour in Buddhism". From the book, it can be said that happiness is a state of mind which has its opposite side that is suffering. As the majority of men cling to security and contentment, there is a "half obscurity" about their condition, as within the hidden and remote recesses of their happiness, there dwells an anxious despair. The Buddha says, though they may be manifold and sweet (*kāmācitrā madhurā*), they cause suffering (*dukkha*), unpleasantness, and turbulence. With some, it becomes an entanglement from which one cannot escape and thus it moves around in a vicious circle. The most important point is that the discord of the pleasure-lover is a facet of Buddhist *dukkha*, though Buddhist *dukkha* has wider ramifications.

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[1] Phramaha Hansa Dhammahaso, **Buddhism and Modern Sciences**, (Thai Version), (Bangkok: Sukhumvit Press Ltd., 2555 B.E.), p. 328.

[2] Padmasiri de Silva, **The Psychology of Emotions and Humour in Buddhism**, (Cham: Palgrave Macmillan, 2018), pp.33, 51-52.

3. Padmasiri de Silva[3] has stated about happiness as peace in a book named "The Psychology of Buddhism in Conflict Studies". From the book, it can be understood that there are many dimensions of 'peace studies', and from a Buddhist perspective peaceful coexistence between human kind and the natural world provides intrinsic metaphors for a holistic peace. In search of an ideal beyond human conflict and violence, and economic imperialism, Bhutan provides the lasting images of integrating many lamps but one light-the best model of 'Cultural Environmentalism'. Bhutan typifies a fine blend of the environment and human peace in harmony.

4. Todd Lewis and Gary DeAngelis[4] have mentioned about happiness and a tool for achievement in a book named "Teaching Buddhism: New Insights on Understanding and Presenting the Traditions" which can be claimed that *sukha* is more associated with mental development than with any form of material acquisition. The most important tool to achieve this mental stage is through training of the mind through meditation to reach the stage of *paññā* (wisdom or insight) the ability to understand reality clearly, everything according to its own nature. Therefore, *paññā* is instrumental in being relieved from pain. With no pain, it will be *sukha* or wellness of the mind, despite the inevitable decline of the mortal body. An individual who perfects his or her *paññā* may experience enlightenment.

5. David Burton[5] has discussed about Buddhist meditation as a tool to achieve peace, freedom and happiness in a book named "Buddhism: a contemporary philosophical investigation".

From the book, it can be concluded that if one reflects seriously on the terrible suffering that attachments can cause, it is hard to dismiss outright the attraction of a life of nonattachment with its promise of peace

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[3] Padmasiri de Silva, **The Psychology of Buddhism in Conflict Studies**, (Cham: Palgrave Macmillan, 2017), p. 22.

[4] Todd Lewis and Gary DeAngelis (eds), **Teaching Buddhism: New Insights on Understanding and Presenting the Traditions**, (New York: Oxford University Press, 2017), p. 351.

[5] David Burton, **Buddhism: a contemporary philosophical investigation**, (New York: Routledge, 2017), p. 29.

and freedom from emotional vicissitudes. A plausible way forward might be to condone attachments to certain things (for example, one's family) and in certain respects (for example, in moderation). In effect, this is what Buddhist lay ethics seeks to achieve, as opposed to the more strenuous pursuit of nonattachment by monastics. Furthermore, even if one rejects the ultimate Buddhist goal of complete nonattachment, the Buddhist meditation and ethical techniques may prevent one from forming excessive or inappropriate attachments. These techniques may also be useful when dealing with the painful consequences of one's attachments.

6. Venerable Mahāsi Sayādaw[6] has stated about kinds of happiness in a book named "On the Nature of *Nibbāna*". From the book, it can be concluded that there are two kinds of happiness, sensual and non-sensual. When six sense-objects supply satisfaction or pleasure, it is called *vedayita sukha*, happiness derived from the senses. While peace and happiness not derived from sensual pleasures constitute *avedayita sukha*. True bliss is *santi sukha*, bliss of peace and serenity. You may think that sensual pleasures give you happiness, but that is not true happiness. No real peace and happiness is possible unless a man is freedom the selfish desire and egoism caused by the threefold craving. It is the way out of this craving the attainment of eternal peace that is taught by the Buddhist doctrine of *nibbāna* as the supreme destiny awaiting all humanity.

7. Ācariya Anuruddha[7] has expounded about the opposite state of happiness (*sukha*) is suffering (*dukkha*) in his great work entitled "The Abhidhammattha Sangaha". From the work, it can implied as in Compendium of Meditation Subjects Topic, there are three aspects of *dukkha*: (1) *dukkha dukkha*, which is ordinary suffering; (2) *vipariṇāma dukkha*, which is suffering experienced by change; and (3) *saṁkhāra dukkha*, which is suffering experienced by conditioned states.

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[6] Venerable Mahāsi Sayādaw, **On the Nature of Nibbāna**, Tr. By U Htin Fatt, Ed. by Bhikkhu Pesala, (Rangoon: Buddha Sāsanānuggaha Organisation, 2013), pp. x, 23.

[7] Ācariya Anuruddha, **A Comprehensive Manual of Abhidhamma (The Abhidhammattha Saṅgaha)**, Gen. Ed. by Bhikkhu Bodhi, Revised and Ed. by Allan R. Bomhard, (Charleston: Buddhist Fellowship, 2007), p. 303.

In the same work, **Bhikkhu Bodhi**, the editor, has further marked with his view towards the second aspect of suffering is *vipariṇāma dukkha*:

> *Vipariṇāma* means "change." It is the nature of this universe that all things constantly change-they are impermanent by nature. Thus, a happy feeling or a happy condition cannot last. When they change, suffering, pain, or unpleasant feelings are the result. "Whatever is impermanent is suffering," said the Buddha. Whenever one is faced with worldly vicissitudes, one experiences suffering in life. The first two aspects of suffering are easy to understand since they are common experiences in daily life. Because these aspects of suffering are readily recognizable as general experiences, they have typically come to stand for the meaning of *dukkha* referred to in the First Noble Truth. However, this does not convey the full meaning of *dukkha* as the Buddha used the term when referring to the First Noble Truth.

8. Bhadantacariya Buddhaghosa[8] has expounded about the etymological definition of *dukkha* in his great work named "The Path of Purification (Visuddhimagga)" which can be understood that *dukkha* [suffering] the word du ("bad") is met with in the sense of vile (*kucchita*); for they call a vile child a *du-putta* ("bad child"). The word *kham* ("-ness"), however is met with in the sense of empty (*tuccha*), for they call empty space "*kham*." And the first truth is vile because it is the haunt of many dangers, and it is empty because it is devoid of the lastingness, beauty, pleasure, and self-conceived by rash people. So it is called *dukkham* ("badness" = suffering, pain), because of vileness and emptiness.

Furthermore, Bhikkhu Ñāṇamoli has explained the reason for translating the term "happiness" as follow:

> In loose usage *pīti* (happiness) and *sukha* (pleasure or bliss) are almost synonyms. They become differentiated in the *jhāna* formulas,

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[8] Vism. 495; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., (Kandy: Buddhist Publication Society, 2010), pp. 506, 82 (footnote No. 6).

and then technically *pīti*, as the active thrill of rapture, is classed under the formations aggregate and *sukha* under the feeling aggregate. The valuable word "happiness" was chosen for *pīti* rather than the possible alternatives of "joy" (needed for *somanassa*), "interest" (which is too flat), "rapture" (which is overcharged), or "zest." For *sukha*, while "pleasure" seemed to fit admirably where ordinary pleasant feeling is intended, another, less crass, word seemed necessary for the refined pleasant feeling of *jhāna* and the "bliss" of *Nibbāna* (which is not feeling aggregate). "Ease" is sometimes used.

2.1.2 Concept of Gross National Happiness (GNH)

1. Kent Schroeder[9] has stated about the significance of GNH in a book named "Politics of Gross National Happiness: Governance and Development in Bhutan" which can be implied that the Gross National Happiness (GNH) is not only a national multidimensional development model for Bhutan but also a defining component of the image of the Bhutanese state itself, portraying an autonomous and coherent entity leading the pursuit of national happiness in partnership with Bhutanese society.

2. Johannes Dragsbaek Schmidt[10] has discussed about barriers of GNH implementation in a book named "Development Challenges in Bhutan: Perspectives on Inequality and Gross National Happiness". From the book, it can be said that a Middle Way path between materialist heedlessness and traditional immobility is a Buddhist choice; a choice between modern growth and traditional stagnation can never be a choice at the extreme but always in the middle of them. Now the issue is: the metaphysical and epistemological justifications of the relevance and utility of GNH has to be grounded in such Buddhist doctrines and philosophy.

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[9] Kent Schroeder, **Politics of Gross National Happiness: Governance and Development in Bhutan**, (Cham, Switzerland: Springer Nature, 2018), p. 21.

[10] Johannes Dragsbaek Schmidt (ed.), **Development Challenges in Bhutan: Perspectives on Inequality and Gross National Happiness**, (Cham, Switzerland: Springer International Publishing, 2017), p. 86.

3. Pema Tshomo [11] has mentioned about The Educating for Gross National Happiness (EGNH) in an anthology entitled "Education in Bhutan: Culture, Schooling, and Gross National Happiness" in which its conclusion can be drawn as the Educating for Gross National Happiness (EGNH) initiative is viewed as one of the main frameworks for the promotion of Gross National Happiness (GNH) in Bhutan. Therefore, in recent years, the nationwide implementation of the EGNH initiative has become the focal point of education reform in Bhutan. As an operational GNH framework, a primary focus of the EGNH initiative is to provide those conditions that lead to quality and equity in education. This chapter evaluates the EGNH framework to assess how the EGNH initiative can provide the necessary conditions for well-being and happiness to enable the pursuit of GNH in Bhutan.

2.2 Theories of Biofeedback

In reviewing the theories of biofeedback in this topic, the two classifications are presented, namely:- (1) Books on Theories of Biofeedback, and (2) Dictionaries and Encyclopedias on Theories of Biofeedback.

2.2.1 Books on Theories of Biofeedback

1. Ingrid Pirker-Binder[12] has mentioned about Biofeedback: Measurement and Training Methods in an anthology named "Mindful Prevention of Burnout in Workplace Health Management: Workplace Health Management, Interdisciplinary Concepts, Biofeedback". From the said work, it can be inferred that one of the biofeedback training methods is called Life-Energy Analysis (LEA) in which its goal is to provide

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[11] Pema Tshomo, "Conditions of Happiness: Bhutan's Educating for Gross National Happiness Initiative and the Capability Approach", in **Education in Bhutan: Culture, Schooling, and Gross National Happiness**, Eds. by Matthew J. - Schuelka and T. W. Maxwell, (Singapore: Springer Science+Business Media Singapore, 2016): 139.

[12] Ingrid Pirker-Binder (ed.), **Mindful Prevention of Burnout in Workplace Health Management: Workplace Health Management, Interdisciplinary Concepts, Biofeedback**, (Heidelberg: Springer International Publishing AG, 2017): 229.

awareness about the use of life energy, the individual activation level, the process of activation and deactivation, and to learn self-awareness and self-control of energy us, so as to facilitate work without energy loss and the adequate use of individual resources in the work process. The Life-Energy-Analysis builds on information gained through Life Script Analysis and Work Script Analysis and supplements this subjective information with biofeedback measurement data and additional holistic measurement methods for the analysis of the stress level.

2. Mark S. Schwartz, Thomas F. Collura, Joe Kamiya, and Nancy M. Schwartz[13] have mentioned about definitions of biofeedback in an anthology named "Biofeedback: a practitioner's guide". From the work, it can be concluded that the term "biofeedback" is a shorthand term for external psychophysiological feedback, physiological feedback, and sometimes augmented proprioception. The basic idea is to provide individuals with increased information about what is going on inside their bodies, including their brains. In essence, biofeedback, used in the broad sense of signals, explanations, and patient education, provides missing or deficient information in the intervention context. This information is helpful for the patient/client, the therapist, or the interaction.

3. Antonio Santoro, Elena Mancini, Ahmad Taher Azar[14] have mentioned about the concept of biofeedback in an anthology named "Modeling and Control of Dialysis Systems Volume 2: Biofeedback Systems and Soft Computing Techniques of Dialysis" which can be inferred as biofeedback is widespread in nature and, in physiology; the term is synonymous of a servosystem, which controls a biological process such as muscular co-ordination and metabolism. A classic example is that

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[13] Mark S. Schwartz, Thomas F. Collura, Joe Kamiya, and Nancy M. Schwartz, "The History and Definitions of Biofeedback and Applied Psychophysiology", in **Biofeedback: a practitioner's guide**, 4th ed., Eds. By Mark S. Schwartz, Frank Andrasik, (New York: The Guilford Press, 2016): 12, 16.

[14] Antonio Santoro, Elena Mancini, Ahmad Taher Azar, "Biofeedback Systems and Their Application in the Hemodialysis Therapy", in **Modeling and Control of Dialysis Systems Volume 2: Biofeedback Systems and Soft Computing Techniques of Dialysis**, Ed. By Ahmad Taher Azar, (New York: Springer, 2013): 1085-1086.

of body temperature regulation, which is kept constant independently of the external temperature. Thermoreceptors continuously measure the core and surface temperatures and send this information to the integration centres. The integration centres, via descending pathways, control the state of the effectors, the skin blood flow, the sweat rate and shivering, and keep the body temperature constant in spite of large changes in the outside temperature. Learning a lesson from nature, bioengineering has codified the basic components of a biofeedback: the process, the sensing elements, the actuators and the controller.

The process is the system that we would like to control, while the sensing elements are devices for measuring the output variable. This is the variable that is measured and compared to the input, i.e. the output's reference value. The controller consists of a mathematical model that continuously sets the measured output variable against the reference input and modifies the actuators in order to reduce the differences between them.

4. Inna Z. Khazan[15] has stated about mindfulness biofeedback step-by-step guide in a book named "The Clinical Handbook of Biofeedback: A Step-by-Step Guide for Training and Practice with Mindfulness". From the book, it can be concluded that a step-by-step guide to integrating mindfulness into your biofeedback practice can be applied in the following 3 steps;

Step 1: Conduct your typical initial evaluation and biofeedback assessment(s). Let your client know that mindfulness and acceptance are a part of how you conduct biofeedback, give a brief introduction to mindfulness, and address any concerns the client might have about the approach.

Step 2: Introduce mindfulness and acceptance of the current experience, allowing it to be the way it is, making no changes. This step is necessary in order to help the client develop awareness of thoughts,

[15] Inna Z. Khazan, **The Clinical Handbook of Biofeedback: A Step-by-Step Guide for Training and Practice with Mindfulness**, (West Sussex: John Wiley & Sons, Ltd., 2013), pp. 16-17.

emotions, and physiological sensations and let go of the struggle with the present experience.

Step 3: Once the client is able to stay with the present experience, begin teaching biofeedback skills with the focus on making mindful changes. As necessary, continue teaching your clients mindfulness practices that may further aid the biofeedback skills you are teaching. Refer to the troubleshooting section for ideas of practices that may be useful as issues come up in biofeedback training.

5. Donald Moss and "Sue" Vietta Wilson[16] have mentioned about biofeedback tools in an anthology named "Case Studies in Applied Psychophysiology Neurofeedback and Biofeedback Treatments for Advances in Human Performance". From the work, it can be concluded as biofeedback Tools for Optimal Performance. The modalities of biofeedback applications in order to optimal performance have utilized the following tools, namely: - (1) surface electromyography (SEMG), (2) electroencephalography (EEG) extensively, (3) temperature, (4) heart rate, (5) heart rate variability, (6) electro-dermal measures, and (7) respiration to a lesser extent.

6. Krista West[17] has discussed about the basic concept of biofeedback in a book named "Biofeedback". From the book, it can be understood that biofeedback is a specific type of feedback that trains the mind to respond to new signals. The mind already knows how to respond to many signals. For example, the mind directs the body to shiver when it is cold. Other signals are less obvious, such as skin temperature, brain waves, and muscle movements. By learning to read these signals, a person can learn to control a variety of mind and body conditions. The

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[16] Donald Moss and "Sue" Vietta Wilson, "The Use of General Biofeedback in the Pursuit of Optimal Performance", in **Case Studies in Applied Psychophysiology Neurofeedback and Biofeedback Treatments for Advances in Human Performance**, Eds. By W. Alex Edmonds and Gershon Tenenbaum, (West Sussex: John Wiley & Sons, Ltd., 2012): 7.

[17] Krista West, **Biofeedback**, (New York: Chelsea House Publishers, 2007), p. 9.

key is to use instruments that make the body's signals available to the mind.

7. Ingrid Pirker-Binder[18] has stated about biofeedback and stress management in a book named "Biofeedback in Practice: Vol. 1 Children" which can be understood that biofeedback can be a means to alleviate a stage of stress. The physical body and emotions blend together. Receives biofeedback in an active stress management process, not just the role as a means of reduction of excessive tension, but, more, a successful biofeedback training gives the individual a sense of subjective control. Connections between emotions and physical reactions are made by means of Biofeedback better perceived and are more controllable. The subjective certainty of being able to influence the current situation is not just Basis of every health thought, but also basis for avoidance from feelings of helplessness.

8. Michael Bar-Eli[19] has stated about a multidimensional model for biofeedback research and application in sport and exercise in an anthology named "Brain and Body in Sport and Exercise: Biofeedback Applications in Performance Enhancement". From the work, it can be claimed that in order to examine a sport/exercise-psychological theory, researchers are advised to conduct empirical investigations that integrate laboratory and field settings, together with computer simulations. As Hatfield and Landers[20] indicates, psychophysiological assessment of athletes should be useful primarily in terms of diagnosis and intervention. The figure below shows such claimed:

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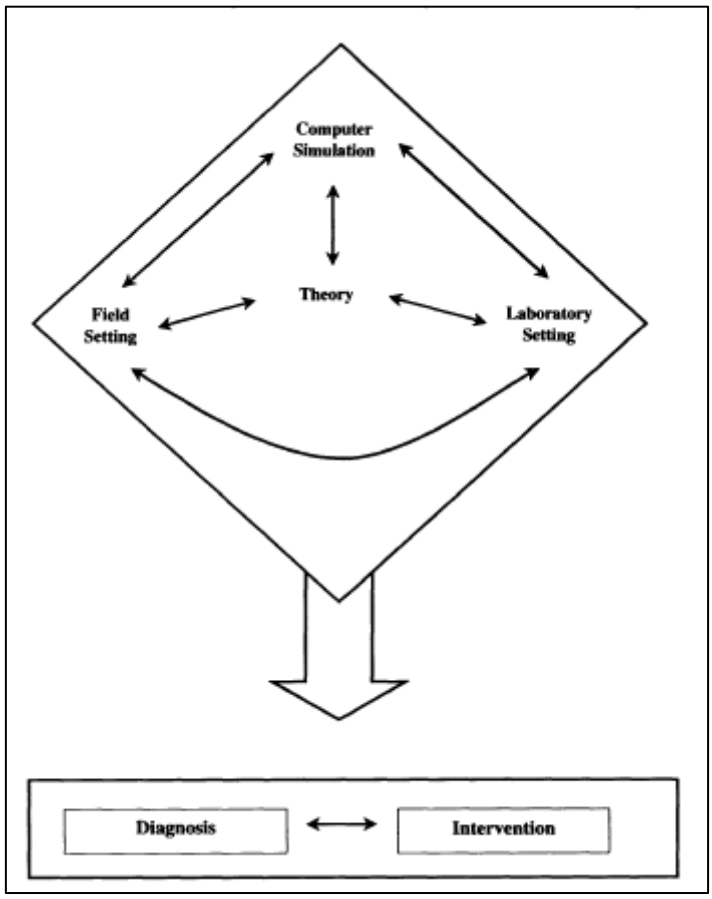
[18] Ingrid Pirker-Binder, **Biofeedback in Practice: Vol. 1 Children**, (Vienna: Springer Publishing Company, 2006), (German Version), p. 122.

[19] Michael Bar-Eli, "Biofeedback as Applied Psychophysiology in Sport and Exercise", in **Brain and Body in Sport and Exercise: Biofeedback Applications in Performance Enhancement**, Eds. by Boris Blumenstein, Michael Bar-Eli, and Gershon Tenenbaum, (West Sussex: John Wiley & Sons, Ltd., 2002): 8-9.

[20] Hatfield, B. D.; Landers, D. M. "Psychophysiology-A new direction for sport psychology", **Journal of Sport Psychology.** No. 5 (1983): 243-259.

Figure 2.1: Multidimensional Framework for Applied Biofeedback Research in Sport and Exercise



Source: Hatfield, B. D.; Landers, D. M., 1983: 256.

2.2.2 Dictionaries and Encyclopedias on Theories of Biofeedback

1. M.S. Bhatia[21] has stated about definition of biofeedback in a dictionary named "Dictionary of Psychology and Allied Sciences" in which the conclusion can be drawn as "biofeedback" refers to provision of information to a subject regarding one or more of his physiological processes in the effort to enable the subject to gain some element of voluntary control over bodily functions that normally operate outside consciousness. In addition, there is another definition that is closely

[21] M.S. Bhatia, **Dictionary of Psychology and Allied Sciences**, (New Delhi: New Age International Publishers, 2009), pp. 49, 237.

related to biofeedback, which is "learned autonomic control" means the learned regulation by a person of physiological responses that are under autonomic nervous system control. Experimental psychologist Neal E. Miller, using biofeedback training techniques demonstrated that such visceral responses are subject to learning.

2. William A. Greene[22] has stated about various application of biofeedback techniques in an encyclopedia named "The Concise Corsini Encyclopedia of Psychology and Behavioral Science".

A conclusion can be drawn as biofeedback is best understood as a closed feedback loop consisting of a person or other animal, a response, a means to detect the response, and a mechanism for displaying the response to the person or animal-the response is thus feedback. It has been applied to athletic performance, Raynaud's disease, cardiac abnormalities, migraine headache, functional diarrhea, tension headache, temporomandibular disorder, essential hypertension, diabetes mellitus, Attention-Deficit/Hyperactivity Disorder, gait disorders, urinary incontinence, nocturnal enuresis, irritable bowel syndrome, tinnitus, fibromyalgia, and asthma, as well as to other problems with autonomic involvement such as anxiety, eczema, and sexual arousal. The applications continue to expand, and biofeedback is, in fact, the method of choice in treating Raynaud's disease.

The application of biofeedback techniques to problems resulting from neuromuscular dysfunction has shown considerable promise. Many reports are available on a wide array of disorders, ranging from headache to foot drop. Neuromuscular feedback has shown impressive specificity of control by successfully training subjects to either activate or inhibit activity of single motor muscle units as well as to control fecal incontinence.

3. Simon Collin[23] has stated about brief definition of biofeedback in a dictionary named "Dictionary of Science and

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[22] William A. Greene, "Biofeedback", in **The Concise Corsini Encyclopedia of Psychology and Behavioral Science**, 3rd ed., Eds. by W. Edward Craighead and Charles B. Nemeroff, (New Jersey: John Wiley & Sons, Inc., 2004): 121-122.

Technology". From the work, it can be concisely concluded the brief definition of biofeedback according to the scientific and technological perspective. The term biofeedback is a noun. It is a term in medicine which literally means the control of the autonomic nervous system by the patient's conscious thoughts as a response to the results of tests or scans.

2.3 A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process

2.3.1 The United Nations Development Programme[24] has mentioned about a strategic model using happiness, peace and well-being as indices and indicators for human development in a report entitled "Human Development Indices and Indicators 2018 Statistical Update"

From the report, it can be inferred that human development is about human freedoms. It is about building human capabilities-not just for a few, not even for most, but for everyone. In 1990 UNDP published the first Human Development Report (HDR). Since then, it has produced more than 800 global, regional, national and subnational HDRs and organized hundreds of workshops, conferences and other outreach initiatives to foster human development. These activities have extended the frontiers of analytical thinking about human progress beyond economic growth, firmly placing people and human well-being at the centre of development policies and strategies. In addition, the sustainable development goal indicator; Goal 16 Indicates an aim to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

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[23] Simon Collin, **Dictionary of Science and Technology**, 2nd ed., (London: A&C Black Publishers Ltd, 2007), p. 72.

[24] The United Nations Development Programme, **Human Development Indices and Indicators 2018 Statistical Update**, (New York: UNDP, 2018), pp. 1, 109, 111.

2.3.2 Sauwalak Kittiprapas[25] has proposed a model of Buddhist Sustainable Development (BSD) in an article entitled "Buddhist Approach and Happiness for Sustainable Development" which can be understood that the Buddhist Sustainable Development (BSD) refers to human-centered sustainable development which is driven by inner happiness in an individual level. This type of development focuses on inner happiness, developed along the path towards highest life's goal of liberalization as well as appropriate systems allowing middle-way of life and middle-way economy. The relationship of human, social, economic, and environment in this system can use less quantity and increase quality of natural resources. This is a pathway towards real sustainable development.

2.4 Related Research Works

In reviewing of related research works, the researcher has carefully reviewed the research works including those Doctor of Philosophy dissertations which related to the significant issues of the study. They are categorized into the four areas, namely: - (1) Related Research Works on Happiness in Buddhism and GNH, (2) Related Research Works on Biofeedback, and (3) Related Research Works on Bi-Dimensional Development.

2.4.1 Related Research Works on Happiness in Buddhism and GNH

1. Dr. Sauwalak Kittiprapas[26] has conducted a research entitled "Buddhist Sustainable Development through Inner Happiness". From the research, it may be concluded that the researcher's proposition portrays a new approach and concept of Buddhist Sustainable Development (BSD), which is human-centered sustainable development, driven by inner happiness (happiness at the mind and wisdom levels). By

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[25] Sauwalak Kittiprapas, "Buddhist Approach and Happiness for Sustainable Development", **The Journal of International Buddhist Studies College (JIBSC)**, Vol.1 No.1 (2015): 107-145.

[26] Dr. Sauwalak Kittiprapas, "Buddhist Sustainable Development through Inner Happiness", **Research Report**, (BKK: International Research Associates for Happy Societies (IRAH) and Faculty of Economics, Rangsit University, Thailand, 2016), pp. iii-iv.

applying Buddhist happiness concepts, human beings can be happy with reasonable and moderated levels of consumption and resource use as well as exhibiting more compassion and loving kindness towards others and nature. Wisdom is essential to develop a high level of happiness; whereas, a high level of consumption and resource use may not lead to an increase in happiness.

The BSD approach, supported by the Buddhist economics concept integrating Buddhist principles into development, provides a new pathway for sustainability with right views towards living and true happiness, also moderation in consumption and in lifestyle. By focusing on analysis of human happiness, BSD extends the conventional widely used sustainable development framework by dealing with the root causes of sustainable development problems arising from human behavior. Thus, the BSD approach can contribute to a possible new approach and solution to the world's development challenges and problems.

2. Kent Schroeder[27] has conducted a Ph.D. Thesis entitled "The Politics of Gross National Happiness Image and Practice in the Implementation of Bhutan's Multidimensional Development Strategy". From the research, it can be concluded that GNH policy implementation is a complex process of conflictive, cooperative and isolating practices characterized by fractured expressions of power. Governance actors have different degrees of influence in different policy fields, geographic regions or constellations of governance actors. These fractured expressions of power are not shaped in any meaningful way by GNH governance instruments. Nor are they rooted in a common understanding of GNH itself. Nonetheless, the development outcomes that emerge often reflect original GNH policy intentions. A common commitment to a set of cultural values-the same values that underlie the official construction of GNH-harmonize fractured expressions of power in a way that is largely consistent with GNH. These values and their outcomes, however,

[27] Kent Schroeder, "The Politics of Gross National Happiness Image and Practice in the Implementation of Bhutan's Multidimensional Development Strategy", **A Doctor of Philosophy Thesis (Political Science and International Development)**, (Graduate School: The University of Guelph, Ontario, Canada, 2014), pp. 295-309.

are often not recognized as being connected to GNH. The result is the frequent achievement of GNH policy outcomes yet the fraying of the image of the Bhutanese state as a coherent GNH state.

2.4.2 Related Research Works on Biofeedback[28]

1. Bin Yu[29] has discussed about the design of "Natural Coupling" for biofeedback interaction for facilitation to a person's understanding of physiological data in his Doctor of Philosophy dissertation entitled "Designing Biofeedback for Managing Stress" It can be concluded that the researcher has attempted to design "Natural Coupling" for biofeedback interaction in order to facilitate the user's understanding of physiological data.

In his design explorations, he practiced the idea of "Natural Coupling" in different interfaces which mainly focused on three aspects of Natural Coupling, namely: - (1) dynamics, (2) modality, and (3) expression;

Modality: Firstly, the sensory modality of biofeedback displays was selected to be in harmony with the user's somatic experience of a self-regulated physiological process. Taking breathing regulation as an example, the human respiration is accompanied by airflow, breath sound, and the expansion/contraction of the chest cavity. When we take deep breathes; our breathing movement can be seen, heard and felt by our senses. In LivingSurface (S2), the wind-driven actuation of the surface was designed to "mirror" the airflow of human breathing. The touch sense (tactile feedback) through the inflation/deflation of BwT enables users to feel the breathing guidance intuitively along with breathing regulation. The up and down of the wind sound in BioSoundscape is also in harmony with the breath sound.

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[28] In presenting this topic, since there are numbers of research works which have been carried out so far on theories of biofeedback with different time frames, therefore, the research team has presented those works in a chronological order starting from the latest work in order to show the development of such theories.

[29] Bin Yu, "Designing Biofeedback for Managing Stress", **Doctor of Philosophy Dissertation (Industrial Design department)**, (Graduate School: Eindhoven University of Technology, 2018), pp. 164-165.

Dynamics: Secondly, the dynamics of interface display (time, position, speed, force) are coupled to the dynamics of the represented physiological processes (respiration rate, heartbeat activities, IBI oscillation). The discrete heartbeat activities are coupled to the discrete vibrations of LivingSurface (S1). A smooth breathing movement makes LivingSurface (S3) bulge and flatten continuously, smoothly and rhythmically.

Expression: Thirdly, the expressions of interface display reflect the physiological processes or indicate the physiological meaning. In the metaphorical visualizations, the static expressions are related to the semantics of the created visual images. The heart rate level is reflected by the size of flower. The flexibility of heart rhythm is reflected by the shape of flower. The stress level is reflected by the appearance of the StressTree. In the other interfaces that present the physiological processes, the aspect of expression is closely related to the dynamics. In DeLight, the breathing movement is reflected by the brightness transferring between a far and a near light. In BioSoundscape, the arousal level is reflected by its richness.

2. Colleen H. Parker; Stanley Henry; and Louis W. C. Liu[30] have mentioned about the efficacy of biofeedback therapy in an article titled "Efficacy of Biofeedback Therapy in Clinical Practice for the Management of Chronic Constipation and Fecal Incontinence". From the paper, it can be concluded that one hundred thirty patients with an average age of 57.5 ± 16.4 years and 79.2% female were included. Of all patients, 43.1% were referred for CC (Chronic constipation), 37.7% for FI (fecal incontinence), 16.9% for alternating CC and FI, and 2.3% for rectal pain. The overall response rate to BFT (Biofeedback therapy) was 76.2% (n=99). Of those that responded, 64.6% (n=64) demonstrated both ARM (anorectal manometry) and symptom improvement, 27.3% (n=27) had ARM improvement but no symptom improvement, and 8.1% (n=8)

[30] Colleen H. Parker; Stanley Henry; and Louis W. C. Liu, "Efficacy of Biofeedback Therapy in Clinical Practice for the Management of Chronic Constipation and Fecal Incontinence", **Journal of the Canadian Association of Gastroenterology**, Vol. XX No. XX (2018): 1-6.

had symptom improvement but no ARM improvement. In patients with FI, the overall response rate was 79.6% (n=39) with symptom improvement in 67.3% (n=33). In those with CC with DD (dyssynergic defecation) (n=53), the overall response rate was 69.8% (n=37); however, only 45.3% (n=24) had symptomatic improvement. In the clinical practice, the overall manometric and symptomatic response rates to BFT are similar to published reports. Patients presenting with CC with DD had a lower symptom response rate compared with those with FI when BFT was limited to three sessions. Given that resources to provide BFT are limited, further studies are needed to determine the components of BFT that are most predictive for symptom response. This will guide optimization of BFT protocols in clinical practice and help optimize the collaboration with other therapists (such as pelvic floor physiotherapists) to provide effective BFT to the patients.

3. Rosalyn Stanton; Louise Ada; Catherine M Dean; and Elisabeth Preston[31] have mentioned about the importance of biofeedback to improve performance in lower limb activities in an article titled "Biofeedback improves performance in lower limb activities more than usual therapy in people following stroke: a systematic review".

From the paper, it can be concluded that the biofeedback can improve the performance in lower limb activities as the findings shown the eighteen trials including 429 participants met the inclusion criteria. The quality of the included trials was moderately high, with a mean PEDro score of 6.2 out of 10. The pooled effect size was calculated as a standardized mean difference (SMD) because different outcome measures were used. Biofeedback improved performance of activities more than usual therapy (SMD 0.50, 95% CI 0.30 to 0.70). Conclusion: Biofeedback is more effective than usual therapy in improving performance of activities. Further research is required to determine the long-term effect on learning. Given that many biofeedback machines are

[31] Rosalyn Stanton; Louise Ada; Catherine M Dean; and Elisabeth Preston, "Biofeedback improves performance in lower limb activities more than usual therapy in people following stroke: a systematic review", **Journal of Physiotherapy,** Vol. 63 (2017): 11-16.

relatively inexpensive, biofeedback could be utilized widely in clinical practice.

4. Paul Lehrer[32] Has mentioned about the importance of Biofeedback in changing psychophysiological substrates of various emotional, physical, and psychosomatic problems, in an article titled "Biofeedback: An Important but Often-Ignored Ingredient in Psychotherapy". From the paper, it can be concluded that Biofeedback is a significant part in a treatment process. It deals in the context of cognitive, behavioral, and psychophysiological dimensions. Although evidence supports the efficacy of biofeedback for treating a number of disorders and for enhancing performance, significant barriers block both needed research and payer support for this method. Biofeedback has demonstrated effects in changing psychophysiological substrates of various emotional, physical, and psychosomatic problems, but payers are reluctant to reimburse for biofeedback services.

5. Erik Peper[33] Has explored about the relationship between the biofeedback theory and yoga in an article titled "Enhancing Yoga with Biofeedback". From the paper, it can be interestingly concluded that with the appropriate biofeedback equipment, one can easily record muscle tension, temperature, blood flow and pulse from the finger, heart rate, respiration, sweating response, posture alignment, etc. Neurofeedback records the brainwaves (EEG: electroencephalography) and can selectively feedback certain EEG patterns. In most cases participants are unaware of subtle physiological changes that can occur. However, when the physiological signals are displayed so that the person can see or hear the changes in their physiology they learn internal awareness that is associated with these physiological changes and learn mastery and control. Biofeedback and neuro feedback is a tool to make the invisible, visible; the unfelt, felt and the undocumented, documented.

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[32] Paul Lehrer, "Biofeedback: An Important but Often-Ignored Ingredient in Psychotherapy", **The Behavioral and Brain Sciences,** Vol. 4 No. 1 (2017): 57-63.

[33] Erik Peper, "Enhancing Yoga with Biofeedback", **Journal of Yoga and Physiotherapy**, Vol. 2 Issue. 2 (2017): 1-4.

Biofeedback can be used to document that a purported yoga practice actually affects the psychophysiology.

6. Esther I. de Bruin; J. Esi van der Zwan; and Susan M. Bögels[34] Have discussed about self-help methods using mindfulness meditations, biofeedback and daily physical exercises, in an article titled "A RCT Comparing Daily Mindfulness Meditations, Biofeedback Exercises, and Daily Physical Exercise on Attention Control, Executive Functioning, Mindful Awareness, Self-Compassion, and Worrying in Stressed Young Adults".

From the paper, it can be shown as the study assessed the effects of daily mindfulness meditations (MM) versus daily heart rate variability biofeedback (HRV-BF) and daily physical exercise (PE) on attention control, executive functioning, mindful awareness, self-compassion, and worrying. Young adults (n = 75, age range 18 to 40) with elevated stress levels were randomized to MM, HRV-BF, or PE, and measurements were taken at pre-test, post-test, and follow-up. Interventions in all three groups were self-guided and lasted for 5 weeks. Generalized estimating equation analyses showed that overall; all three interventions were effective and did not differ from each other. However, practice time differed between groups, with participants in the PE group practicing much more than participants in the other two groups. Therefore, additional analyses were carried out in two subsamples. The optimal dose sample included only those participants who practiced for at least 70 % of the total prescribed time. In the equal dose sample, home practice intensity was equal for all three groups. Again, the effects of the three interventions did not differ.

In conclusion, MM, HRV-BF, and PE are all effective self-help methods to improve attention control, executive functioning, mindful awareness, self-compassion, and worrying, and mindfulness meditation

[34] Esther I. de Bruin; J. Esi van der Zwan; and Susan M. Bögels, "A RCT Comparing Daily Mindfulness Meditations, Biofeedback Exercises, and Daily Physical Exercise on Attention Control, Executive Functioning, Mindful Awareness, Self-Compassion, and Worrying in Stressed Young Adults", **Mindfulness,** Vol. 7 (2016): 1182–1192.

was not found to be more effective than HRV-biofeedback or physical exercise for these cognitive processes.

7. Urszula Klich[35] Has mentioned about an integration between compassion and mindfulness-based biofeedback (MBB) treatment approach in an article titled "The Integration of Mindfulness-Based Biofeedback and Compassion in the Healthcare Setting". From the paper, it can be concluded that in biofeedback treatment, the aim is to entrain successive changes in performance and ability to self-regulate. In mindfulness-based meditation, a main objective is to increase awareness of self in relation to the world. Through merged compassion and mindfulness-based biofeedback (MBB) treatment approaches, a collective goal is to provide individuals with more in-depth and varied training in developing skills such as self-awareness and self-regulation. Consistent with traditional mindfulness-based techniques is the notion of increasing awareness and practicing non-judgment and acceptance.

In conclusion, through mindfulness, compassion, and biofeedback, we increase self-awareness and simultaneously decrease anxiety. Biofeedback is a powerful tool through which one can utilize psychophysiological training to further develop, promote, and refine the skills necessary for compassion. With practice, skills born of each modality not only become polished over time but also appear to have a reciprocally beneficial and additive effect. If we combine conscious attention and focusing practices from traditional meditation with the precision that biofeedback training affords, then it is possible to change the habitual processes of the brain to function more effectively and perhaps efficiently.

8. Taychapat Makkong and Silapachai Suwantada[36] Have discussed about the expectable results of biofeedback training program, in

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[35] Urszula Klich, "The Integration of Mindfulness-Based Biofeedback and Compassion in the Healthcare Setting", **Biofeedback,** Vol. 43 Issue 3 (Fall 2015): 111-116.

[36] Taychapat Makkong and Silapachai Suwantada, "Effects of Biofeedback Training Program on Anxiety and Shooting Accuracy of Secondary School Shooters" (Thai Version), **Journal of Sports Science and Health**, Vol.16 No.2, (May-August 2015): 14-24.

an article titled “Effects of Biofeedback Training Program on Anxiety and Shooting Accuracy of Secondary School Shooters”.

From the paper, it can be inferred that after 3 weeks, the experimental group had low frequency and high frequency in heart rate variability significantly better than the control group at the level of 0.05. the experimental group had shooting accuracy, low frequency and high frequency in heart rate variability significantly better than the pretest but all control group means were not significantly better than the pretest. Anxiety score from Competitive State Anxiety Inventory-2 Revised (CSAI-2R) were not significant differences at the 0.05 level in the same group and between groups. In conclusion, heart rate variability biofeedback does improve heart rate variability and shooting accuracy significantly in secondary school shooters. Anxiety had tendency to decrease in somatic and cognitive anxiety and self-confidence had tendency to increase but all anxiety scores are not significance better than pretest.

9. Kanokporn Thongkhum; Manyat Ruchiwit and Chomchuen Somprasert[37] Have discussed about the integrative program between biofeedback and meditation training towards the stress levels, in an article titled “The Effect of Meditation Training together with a Biofeedback Training Program on the Stress Levels of Chronic Disease Patients”.

From the paper, it can be concluded as follows: - (1) for the first experimental group, the mean scores on the SOSI, SC, ST before and after the treatment were statistically significantly different ($p<.0005$); (2) for the second experimental group, the mean scores on the SOSI , SC, ST before and after the treatment were statistically significantly different ($p < .0005$); and (3) for the first and the second experimental group, and the control group, the mean scores of the SOSI, SC and the ST were statistically significantly different ($p<.0005$) ($F(6,188) = 14.24$, $p = .000$,

[37] Kanokporn Thongkhum; Manyat Ruchiwit; Chomchuen Somprasert, “The Effect of Meditation Training together with a Biofeedback Training Program on the Stress Levels of Chronic Disease Patients” (Thai Version), **Nursing Journal**, Vol. 42 No. 1 (Janurary-March 2015): 24-37.

Wilks' Λ = 0.47, partial $\eta 2$ = .31). In conclusion, meditation training together with a biofeedback training program could reduce the stress levels of patients with chronic disease. This may be an alternative way for designing a program of care for patients with chronic disease.

10. Poppy L. A. Schoenberg and Anthony S. David[38] have mentioned about the potential of Biofeedback in providing non-invasive, effective psychophysiological interventions for psychiatric disorders, in an article titled "Biofeedback for Psychiatric Disorders: A Systematic Review". From the paper, it can be concluded that biofeedback potentially provides non-invasive, effective psychophysiological interventions for psychiatric disorders. Electroencephalographic neurofeedback constituted the most investigated modality (31.7 %). Anxiety disorders were the most commonly treated (68.3 %). Multimodal biofeedback appeared most effective in significantly ameliorating symptoms, suggesting that targeting more than one physiological modality for bio-regulation increases therapeutic efficacy.

However, it is worthy to note that biofeedback may not be useful for disorders characterized by limited or low physiological responsivity, difficulties in recognizing physiological/affective states, or where physiological mechanisms are not centrally involved in the onset and perpetuation of symptoms (e.g. personality disorders). Albeit, whilst it does not appear logical to administer biofeedback treatments to the aforementioned disorder typologies, the potential efficacy of biofeedback upon 'opening' introspective mind–body channels within such patients which could then enhance patient-therapist interaction and/or personal insights, thus enacting nonlinear psychological benefits, has not been explored.

11. Tracy Brandmeyer and Arnaud Delorme[39] have mentioned about the possible advanced integration between meditation

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[38] Poppy L. A. Schoenberg; Anthony S. David, "Biofeedback for Psychiatric Disorders: A Systematic Review", **Appl Psychophysiol Biofeedback**, Vol. 39 (2014): 109-135.

[39] Tracy Brandmeyer; Arnaud Delorme, "Meditation and Neurofeedback", **Frontiers in Psychology**, Vol. 4 Article 688 (October 2013): 1-3.

and neurofeedbask, in an article titled “Meditation and Neurofeedback”. From the paper, it can be inferred that neurofeedback should be used as an aid to meditation while people perform their meditation and not as a replacement to meditation, and that while these devices may aid and assist those in their meditative practices, the goal of these practices themselves is ultimately the decrease of reliance on objects and constructs that provide support. This type of research should also integrate neurophenomenological approaches that take into account first-person reports of subjective experience in conjunction with the experimental investigation of brain activity. Real time feedback of brain activity as implemented in neurofeedback may help develop new frameworks for the scientific investigation of embodied consciousness and the interactions between mind and body.

12. Jahanbazi A; Chitsaz A; Asgari K[40] Have discussed about the pleasurable effects of EMG Biofeedback, in an article titled “Effects of EMG Biofeedback on Pain and Quality of Life in Cervical Dystonia”.

From the paper, it can be denoted that the biofeedback devise may use a meter to show the current level of tension, or send a signal with bar graph, a beeping sounder or a visual display on a computer screen. In each case, the person who receives immediate information about the level of tension in muscle group can learn to better assess the tension him or herself, and can also learn to relax the muscle. That process is helpful for CD (cervical dystonia) patients, whose high muscle tension often worsens pain and abnormal postures.

13. Nasya Brenda Breach[41] has discussed about the theory of biofeedback in terms of HRV biofeedback protocol in the treatment of major depression in her Doctor of Psychology dissertation entitled “Heart

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[40] Jahanbazi A; Chitsaz A; Asgari K. “Effects of EMG Biofeedback on Pain and Quality of Life in Cervical Dystonia”, **J Neurol Disord**., Vol. 2 Issue 1 (2013): 144.

[41] Nasya Brenda Breach, “Heart Rate Variability Biofeedback in the Treatment of Major Depression”, **Doctor of Psychology Dissertation (Applied and Professional Psychology)**, (Faculty of the Graduate School: Rutgers, the State University of New Jersey, 2012), pp. ii-iii, 31-33.

Rate Variability Biofeedback in the Treatment of Major Depression". The research's objectives were (1) to evaluate the efficacy of a HRV biofeedback protocol by comparing it to a sham control protocol with similar demand characteristics, and (2) to evaluate the feasibility, tolerability and effectiveness of this placebo. In conducting the research, eleven participants were recruited from the UMDNJ-University Behavioral Health Care population and surrounding communities, and were randomized to a treatment group, receiving ten weeks of HRV biofeedback training and home practice, or a control group, receiving ten weeks of sham respiratory biofeedback training and home practice.

From the research, it can be inferred that the primary outcome measures were the HAMD and the BDI-II; assessed at baseline, week four, week seven, and week ten. Results indicated no significant differences in depression symptom improvement between groups, although significant main effects for time were observed for both groups ($p<.05$). Results did, however, support the utility, feasibility, and tolerability of the credible sham respiratory control protocol.

In addition, the decreased parasympathetic modulation has been attributed to impaired activity of the vagus nerve, as indexed by attenuated heart rate variability (HRV) at the respiratory frequency. Areas of the brain that are involved in emotion regulation influence vagus nerve functioning. HRV biofeedback has been shown to be a modality through which individuals can learn to increase the amplitude of their HRV oscillations by breathing at specific rates. Through HRV biofeedback, the vagus nerve is thought to be stimulated in such a way that promotes autonomic balance and improved emotion regulation. Previous research suggests that HRV biofeedback may significantly reduce depression symptoms. The current study was a preliminary efficacy, randomized controlled trial that intended to follow-up an open label pilot study previously conducted by this lab, which found HRV biofeedback to be effective at significantly reducing depressive symptoms.

14. Liyun Guo[42] has mentioned about the theory of biofeedback in terms of applying the biofeedback system to wheelchair propulsion analysis and design, in his Doctor of philosophy dissertation entitled "Development and Testing of a Biofeedback System for Wheelchair Propulsion Analysis". From the research, it can be concluded that within the Project, the OptiPush Biofeedback System was designed, implemented, validated and tested. Physically, the system provides simple installation on most wheelchairs for a variety of wheel sizes. Functionally, the system provides acceptable accuracy and low error in measurements of wheel angle, speed, and hand rim loading (in both static and dynamic conditions). The system calculates several variables that related to propulsion technique and provides this information to users as a real-time biofeedback. Testing of the biofeedback revealed a viable means of improving propulsion technique. Participants were able to make significant and controlled changes to both single and multi-variables biofeedback.

The Project successfully developed the instrumentation and software necessary to provide wheelchair users with real-time biofeedback on their propulsion stroke. The structure of the biofeedback was tested and refined in a series of human subject trials. The user testing revealed that propulsion technique could be altered and controlled with the use of biofeedback. It was also learned that there were competing interests between reducing push cadence and reducing peak hand rim force. Repetitive stress injuries are likely influenced by either the magnitude of the joint loading, the repetition of the joint loading, or both. Because the exact etiology of overuse injuries in this population is not clear, it is ideal if both of these factors can be reduced. The final OptiPush biofeedback design included a multi-variable push stroke graph of peak force verses contact angle that was shown to enable the user to reduce both their peak hand rim force and their push cadence concurrently.

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[42] Liyun Guo, "Development and Testing of a Biofeedback System for Wheelchair Propulsion Analysis", **Doctor of Philosophy Dissertation (Mechanical Engineering)**, (Faculty of the Graduate School: Vanderbilt University, 2012), pp. 68, 73-74.

15. Auditya Purwandini Sutarto; Muhammad Nubli Abdul Wahab; Nora Mat Zin Brandmeyer and Arnaud Delorme[43] Have discussed about the effectiveness of HRV biofeedback to the improvement of some cognitive functions of individual, in an article titled "Heart Rate Variability (HRV) biofeedback: A new training approach for operator's performance enhancement". From the paper, it can be said that the individual's cardiovascular response or heart rate variability (HRV) biofeedback training works by teaching people to recognize their involuntary HRV and to control patterns of this physiological response. The training is directed to increase HRV amplitude that promotes autonomic nervous system balance. This balance is associated with improved physiological functioning as well as psychological benefits. Most individuals can learn HRV biofeedback training easily which involves slowing the breathing rate (around six breaths per minute) to each individual's resonant frequency at which the amplitude of HRV is maximized. Maximal control over HRV can be obtained in most people after approximately four sessions of training. Recent studies have demonstrated the effectiveness of HRV biofeedback to the improvement of some cognitive functions in both simulated and real industrial operators.

16. Catherine Andrea Prato[44] has studied about a biofeedback assisted relaxation training program as a means to reduce the anxiety in her dissertation entitled "Biofeedback assisted relaxation training program to decrease test anxiety in nursing students". Its purposes were twofold: - (1) to measure test anxiety across the four semesters of a nursing program to determine if test anxiety differed by semester, and (2) to test a biofeedback assisted relaxation training program as a means to reduce test anxiety in undergraduate nursing students who self-reported

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[43] Auditya Purwandini Sutarto; Muhammad Nubli Abdul Wahab; Nora Mat Zin Brandmeyer; Arnaud Delorme, "Heart Rate Variability (HRV) biofeedback: A new training approach for operator's performance enhancement", **JIEM**., Vol. 3 No. 1 (2010): 176-198.

[44] Catherine Andrea Prato, "Biofeedback assisted relaxation training program to decrease test anxiety in nursing students", **Doctor of Philosophy (Nursing) Dissertation**, (Graduate College: University of Nevada, 2009), p. iii-v.

test anxiety. Anxiety was measured subjectively using Spielberger's Test Anxiety Inventory (TAI) and objectively by monitoring peripheral skin temperature, pulse rates, and respiration rates during the biofeedback assisted relaxation training program.

From the dissertation, it can be inferred as the findings showed statistically significant changes in respiratory rates and skin temperatures during the diaphragmatic breathing session; changes in respiratory rates and peripheral skin temperatures were statistically significant during the progressive muscle relaxation training session, and statistically significant changes in respiratory rates, peripheral skin temperatures, and pulse rates were found during the autogenic training sessions.

In conclusion, the subjective test anxiety scores of the students did not decrease by the end of the biofeedback assisted relaxation training program. The students were able to learn how to control their respiratory rate, and as a result peripheral skin temperatures increased significantly during each training session. The training strategy that resulted in the greatest change in physiological measures, and presented the most significant findings was the autogenic training session.

17. Cynthia J. Tanis[45] has studied about the theory of biofeedback particularly on the heart rhythm variability biofeedback and emotional regulation in her dissertation entitled "The Effects of Heart Rhythm Variability Biofeedback with Emotional Regulation on the Athletic Performance of Women Collegiate Volleyball Players" with 2 purposes, namely: - (1) to investigate the effects of heart rhythm variability (HRV) biofeedback training with emotional regulation on the athletic performance of women collegiate volleyball players, and (2) to examine the participant's ability to self-regulate and her perception of the intervention. Individual biofeedback training using the emWave® PC (1.0) was provided to 13 student-athletes during six weekly sessions. A portable biofeedback device known as the emWave® PSR was available

[45] Cynthia J. Tanis, "The Effects of Heart Rhythm Variability Biofeedback with Emotional Regulation on the Athletic Performance of Women Collegiate Volleyball Players", **Doctor of Philosophy Dissertation**, (Graduate School: Capella University, 2008), p. i.

for independent self-regulation rehearsal. The research was a quasi-experimental, repeated measure, mixed-methodology, within-subject design.

The quantitative results supported the hypothesis that the team and its 13 participants self-regulated at will. The results did not support the hypothesis that the intervention improved performance. One possibility for this finding was the presence of a statistical and performance ceiling effect. The qualitative results revealed a positive perception of the intervention relating to the participants' roles as students, athletes, and team members.

In additions, numerous themes emerged from the interviews reflecting the benefits of the intervention.

(a) Learning about biofeedback and self-regulation while visualizing the heart rhythm on the computer screen.

(b) Improving self-awareness and increasing self-control.

(c) Reducing the effects of physical and mental stress relating to academic and athletic rigors.

(d) Experiencing enhanced physical and mental states improving academic and athletic performance.

(e) Improving team composure and camaraderie. Although further research is warranted, the results of this innovative intervention demonstrate the potential to enhance academic and athletic performance in collegiate sport.

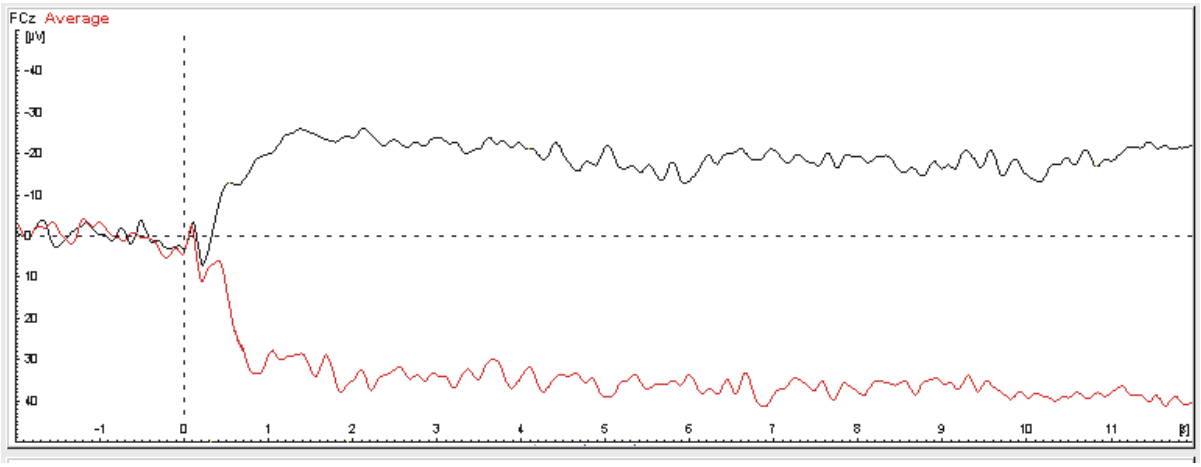
18. Mehmet Eylem Kirlangic[46] has mentioned about the theory of biofeedback in terms of the EEG-Biofeedback and Non-Linear Phase Transitions in his dissertation entitled “EEG-Biofeedback and Epilepsy: Concept, Methodology and Tools for (Neuro) therapy Planning and Objective Evaluation”. From the research, it may be concluded that many

[46] Mehmet Eylem Kirlangic, “EEG-Biofeedback and Epilepsy: Concept, Methodology and Tools for (Neuro) therapy Planning and Objective Evaluation”, **Doctor of Engineering Dissertation**, (Faculty of Computer Science and Automation: Ilmenau Technical University, 2004), pp. 104, 107.

processes of coordination and regulation in human physiology involve phase transitions with nonlinear and non-stationary properties, so does SCP based neurofeedback. The results of a training session, in which the tasks of negativation and positivation are successful,[47] indicate non-linear phase transitions to these two states. Such spontaneous phase transitions are commonly observed where a system changes its macroscopic state qualitatively [114]. For phase transitions of systems in thermal equilibrium the adequate treatment of fluctuations could be solved by renormalization group techniques. However, for systems far from thermal equilibrium (i.e., non-equilibrium phase transitions), the phenomena and the problem get more complex, and need novel approaches.

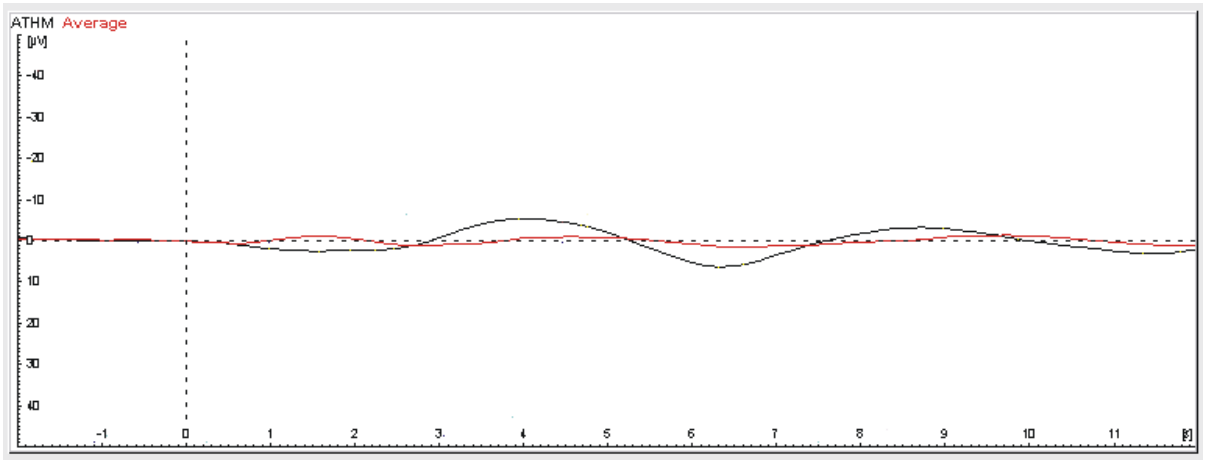
Figure 2.2: Results of an EEG-biofeedback Session based on SCP

Source: Mehmet Eylem Kirlangic, 2004: 104.

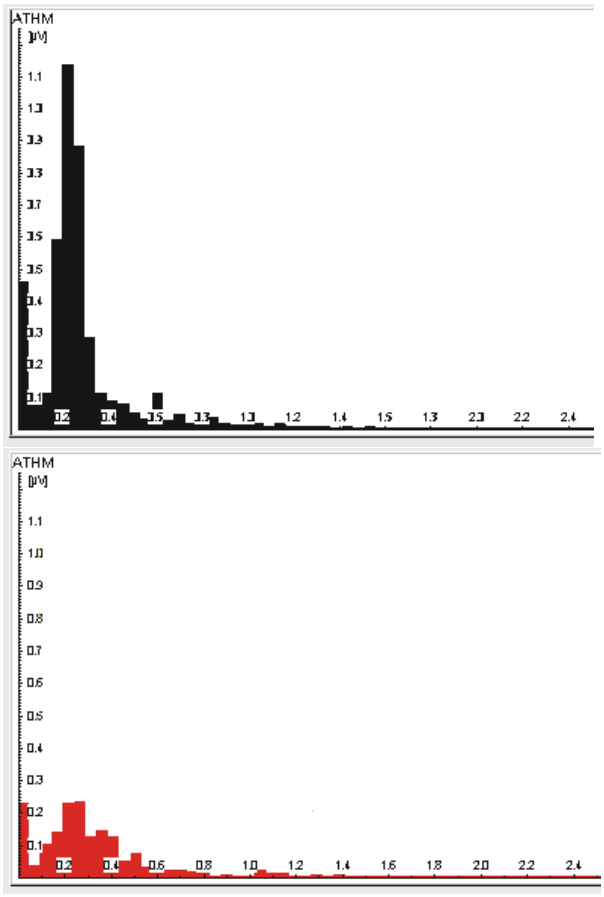


(a)

[47] See Fig. 2.2



(b)



(c) (d)

From the above figures, the results of an EEG-biofeedback session based on SCP (black: negativation task, red: positivation task), can be shown respectively:- (a) feedback channel Fcz, (b) respiration channel ATHM, and corresponding spectral power of the respiration

channel (c) negativation task, (b) positivation task. © RGESIM/ASIM Verlag-Proceedings of World Congress on Neuroinformatics.

19. James Brik[48] has discussed about the effects of EMG Biofeedback training and relaxation training in his Doctor of Education Thesis entitled "The Effects of EMG Biofeedback Training and Relaxation Training on Self-Reported Measures of Trait Anxiety and Sports Competition Anxiety". From the work, it can be inferred that 4.2.3 Ways of Biofeedback Process EMG measures were significantly reduced through the six weeks of training using relaxation training alone, biofeedback training, and combined relaxation/biofeedback training. There were no differences as a result of treatment effect for the variables for between group significance for any of the variables to include Trait Anxiety, Sports Competition Anxiety, Locus of Control, blood pressure, and resting heart rate.

2.4.3 Related Research Works on Model of Bi-Dimensional Development

1. Phrakrupalad Marut Varamangalo, Asst.Prof.Dr.[49] has mentioned about development of mind in the research report "An Analytical Study of Buddhist Psychology in Tipitaka". The findings can be concluded that Buddhism examines mind and its process of working in terms of practice for mental training by doing meditation both in tranquil and insight meditation. The aim is to enhance the capability of mind in order to overcome or control the defilements. Therefore, the said practice can be utilize to individual's life and social in various ways, in terms of learning, teachings, self-development and a solution to suffering by Buddhist counselor method.

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[48] James Brik, "The Effects of EMG Biofeedback Training and Relaxation Training on Self-Reported Measures of Trait Anxiety and Sports Competition Anxiety", **Doctor of Education Thesis (Education)**, (Graduate School: Oregon State University, 1984), p. Abstract page.

[49] Phrakrupalad Marut Varamangalo, Asst.Prof.Dr., "An Analytical Study of Buddhist Psychology in Tipitaka", **A Research Report, Department of Pariyattidhamma and Cariya Studies**, (Faculty of Education: Mahachulalongkornrajavidyalaya University, 2010), p. Abstract A.

2. Phrakru Sirirattananuwat, Assoc. Prof. Dr.[50] has mentioned about Bi-Dimensional development through the methods of well-being promotion according to Buddhist Psychology in the research report "Concept and the Process of Health Promotion according to Buddhist Psychology". The findings show that the well-being promotion generally refers to the prevention of accidents such as campaigning on road vehicles during the festival by eliminating drinking alcoholic drink; campaigns to eliminate mosquito in the household; fire warning campaigns; AIDS prevention campaigns; campaigning on Respiratory Infected Diseases; including mental illness; depression, severe stress or nervous system diseases, etc. These diseases can be protected by the method of health promotion according to Buddhist Psychology, in two ways: (1) Physical health promotion, and (2) Mental health promotion. That is to define the happiness in two ways, namely: (1) Physical happiness, and (2) Mental happiness. The following methods are to promote health.

Healthy elements focus on physical well-being with environmental protection; mental well-being deals with concentration; intellectual well-being deals with wisdom augmentation; social well-being deals with good society and social works. The importance of well-beings focuses on good health. The Buddhist teachings relating to well-beings focus on the four foundations of mindfulness, the four development. The methods of well-being promotion focus on the three methods, namely: Realization on the value of life, managing for health care expenditures, and being careful in the causes of ruin (*apāyamukha*).

3. Sanu Mahatthanadull[51] has mentioned about the BALANCE Model explaining equilibrium of Bi-Dimensional

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[50] Phrakru Sirirattananuwat, Assoc.Prof.Dr., "Concept and the Process of Well-being Promotion according to Buddhist Psychology", (Thai Version), **A Research Report Funded by National Research Council of Thailand (NRCT) Fiscal Year 2016**, (Buddhist Research Institute: Mahachulalongkornrajavidyalaya University, 2018), pp. 47-49.

[51] Sanu Mahatthanadull, "Buddhist Integrated Approach for the Equilibrium of Human Body Systems", (Thai Version), **Ph.D. Dissertation in**

development of life and factors contributing to such development in his dissertation “Buddhist Integrated Approach for the Equilibrium of Human Body Systems”.

The research findings can be concluded as in the Buddhist viewpoint, the human body systems cannot maintain by themselves, but they have to depend on the supporting factors both internal and external to cause those systems to maintain forever according to the principle of *Paṭiccasamuppãda*. When these factors are of suitable relationship, the equilibrium will arise. Therefore, in Buddhism, there is a way of setting up the equilibrium of the human body systems by using the items of the practice suitable for those life-supporting factors according to the principle of the Middle Path.

The approach to the equilibrium of the human body systems harmonizing with the living according to the principle of balance can be setting up in the relationships of the life equilibrium of 4 levels, namely;- the physical equilibrium, the moral equilibrium, the emotional equilibrium and the wisdom equilibrium respectively. It is true to the model named:- BALANCE Model: The Six Components to The Equilibrium of The Human Body Systems, consisting of the six vital components, namely;- 1. *Mahãbhũtarũpa*, 2. The in-breath and the out-breath, 3. The posture, 4. The fire-element, 5. The edible food, 6. *Viññãṇa-Dhãtu*.

4. Asst. Prof. Dr. Sanu Mahatthanadull and Dr. Sarita Mahatthanadull[52] have discussed about Bi-Dimensional development and a state of happiness (s*ukha-bhāva*) in a research report “Holistic Well-beings Promotion for Balanced Way of Life according to Buddhist Psychology”.

Buddhist Studies, (Graduate School: Mahachulalongkornrajavidyalaya University, 2549 B.E.), pp. Abstract A-B, 127.

[52] Asst. Prof. Dr. Sanu Mahatthanadull and Dr. Sarita Mahatthanadull, “Holistic Well-beings Promotion for Balanced Way of Life according to Buddhist Psychology”, **Research Report**, (Buddhist Research Institute: Mahachulalongkornrajavidyalaya University, 2559 B.E.), pp. 137-138.

It can be inferred that the balanced way of life of human beings represents a state called "*Sukha-bhāva*" or a perfect health that arise subject to the normal nature as it is. The modern medical theory calls this balance "Well-being" is a harmonic state amongst body, mind, and the environment including consciousness entities. The balanced way of life of human beings closely related with the holistic well-beings in the following manner. First, the physical well-being (Innate Body) denotes the balance of way of life when the physiological needs are fulfilled. Second, the moral well-being (Social Morality) connotes the balance of way of life when the Safety and social needs are fulfilled. Third, the mental well-being (Calm Mind) means the balance of way of life when the esteem needs are fulfilled. Last, the intellectual well-being (Awakening Wisdom) denotes the balance of way of life when the self-actualization needs are fulfilled.

There are four ways of promotion of holistic well-beings for balanced way of life according to Buddhist Psychology, namely: - (1) Physical Well-being Promotion for Balanced Way of Life according to Buddhist Psychology, (2) Moral Well-being Promotion for Balanced Way of Life according to Buddhist Psychology, (3) Mental Well-being Promotion for Balanced Way of Life according to Buddhist Psychology, and (4) Intellectual Well-being Promotion for Balanced Way of Life according to Buddhist Psychology.

5. Phra Dhammamoli (Thongyu Ñāṇavisuddho)[53] discusses about the principle of Bi-Dimensional development and happiness in the dissertation "An Analytical Study of Lifestyle, Health Behaviors and Holistic Health Care of the Buddhist Monks as Appeared in the Tipitaka".

The research findings can be concluded that Holistic development according to Buddhism means happiness and completion of life in overall picture. It shows in two ways: physical happiness (*kāyika-sukha*) and mental happiness (*cetasika-sukha*). The elements of holistic

[53] Phra Dhammamoli (Thongyu Ñāṇavisuddho), "An Analytical Study of Lifestyle, Health Behaviors And Holistic Health Care of the Buddhist Monks as Appeared in the Tipitaka", (Thai Version), **A Ph.D. Dissertation**, (Graduate School: Mahachulalongkornrajavidyalaya University, 2551 B.E.), p. abstract A.

well-beings can be classified into four areas, namely: (1) physical, (2) mental, (3) moral is social and environment, and (4) wisdom. The well-beings or happiness will arise in human life, all mentioned dimensions must work together in one, and they must have been developed to perform its functions perfectly and normally.

In conclusion, from the above reviewed of related literatures and research works, it can be seen obviously that there is still no direct research both in the matters of the concept of happiness access; GNH; the theories of Biofeedback; and the conceptual model. Thus the research team should study further scrupulously on this particular matter “A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process” in order to propose universally such model that conceptually explains the Bi-Dimensional development of human’s mind and wisdom by using the Biofeedback Process in order to make accessible to a state of happiness in life of mankind.

Chapter III

Research Methodology

In the study of this research "A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process", the following three objectives are to be examined, namely: - (1) to explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH), (2) to examine the theory of biofeedback, and (3) to propose a conceptual model of bi-dimensional development for happiness access by biofeedback process.

The research methodology can be presented in six areas, namely: (1) Format of the Research, (2) Populations and Samples and Key Informants, (3) Research Tools, (4) Collection of Data, (5) Data Analysis, and (6) Summary of the Research Process. Details for each area are as follows:

3.1 Format of the Research

This is a qualitative research work. The methodology of the research has been established employing the research materials and instruments, such as the collection and analysis of data from primary and secondary sources, in-depth interviews and the use of technological devices, etc. For the purpose of the research findings which creates the series of body of knowledge respectively based on the research's objectives, in terms of (1) the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH), (2) the theory of biofeedback, and (3) the proposed conceptual model of bi-dimensional development for happiness access by biofeedback process.

3.2 Populations, Samples and Key Informants

Due to the fact that this work is a qualitative research by analyzing of data from documents and field studies relating to the presenting of A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process. Thus the area, population and samples are focused on both local and international organizations with working processes that focus on studying and learning Buddhist happiness access as well as the process of biofeedback consisting in the human's bodies.

Hence the sample population that appeared in this research concerns with groups of 8 key-informants who are monks and Buddhist scholarly representatives with knowledge of Buddhism and sciences. They are expertise in interdisciplinary integration into education and way of life sciences. There are totally 6 countries among the regional and international organizations around the world, namely: - (1) Thailand, (2) Bhutan, (3) United Kingdom, (4) United States, (5) India, and (6) Sri Lanka. Name lists are given as follows:

1. Most Venerable Professor Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand;

2. Venerable Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan;

3. Venerable Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand;

4. Emeritus Professor Dr. Peter Harvey, University of Sunderland, United Kingdom;

5. Professor Dr. Phillip D. Stanley, Naropa University, Colorado, United States;

6. Professor Dr. Geeta Manaktala, Panjab University, Chandigarh, India;

7. Emeritus Professor Dr. Pahalawattage Don Premasiri, University of Peradeniya, Sri Lanka;

8. Dr. Supriya Rai, Director, K. J. Somaiya Centre for Buddhist Studies, India.

For the purpose of the selection of the samples, it is done by setting up representatives from such organizations and countries. In addition, the purposive random sampling technique was significantly used based on the significance of the studies.

3.3 Research Tools

The research tools enable the research team to construct concepts and theories, managing with those data and information, as well as systemic model proposal eventually. The essential research tools employed in this work consists of in-depth interview's forms as well as the use of technological devices in data collection and analysis, such as systematic analysis of related equipment. So the exploration is in accordance with the process involved to the sample in various organizations.

The in-depth interview's forms were examined in terms of the Item-Objective Congruence (IOC) by the 3 experts, namely:

1. Most Venerable Associate Professor Dr. Phra Methavinairos, Mahamakut Buddhist University, Thailand,

2. Associate Professor Dr. Praves Intongpan, Department of Philosophy and Religion, Faculty of Humanities, Kasetsart University, Thailand, and

3. Associate Professor Dr. Amnaj Buasiri, Committee of Education Council, Ministry of Education, Thailand.

However, the research tools that have been chosen and employed to be suitable for the types of research are listed as follows:

1. Question forms for in-depth interviews,
2. Personal computer and equipment's,
3. Laptop computer and equipment's,
4. Internet system,
5. Photographs,
6. Camera,

7. Audio recordings,
8. Etc.

These said tools are effective and important for conducting research throughout the research process from beginning to the end.

The abovementioned question forms for in-depth interviews with the Item-Objective Congruence (IOC) were examined by 3 experts. The forms consisted of four key questions which mainly based on the three objectives of the research as well as the research's problems. They are as follows:

Question 1: What do you think are the practices of happiness access according to Buddhist principle?

Question 2: Numbers of researches have been indicated that meditation or concentration (*Samādhi*) can significantly affects the physical body by affecting the body feedback; Brain waves, vital sign, heart rate, blood pressure, stress hormone, etc. This is called Bio-Feedback that underlines *Samadhi* as input can creates towards body feedback as output.

How does meditation work in the process of Mind-body in Biofeedback in your opinion?

Question 3: Based on the four dimensions of development in Buddhism, namely:- (1) Physical body development (*kaya-bhavanā)*, (2) moral development *(sīla-bhavanā*), (3) mental development *(citta-bhavanā*) and (4) wisdom development *(paññā-bhavanā*).

How are MENTAL development and WISDOM development related?

Question 4: From the following concepts about happiness access in Buddhism, Gross National Happiness (GNH), and the theory of biofeedback, what do you think of the features of the Conceptual Model of Bi-dimensional Development for Happiness Access by Biofeedback Process should look like?

3.4 Collection of Data

This research is a qualitative study using qualitative method as a basis for research starting by collecting data from the primary source of Pali Canon (*Tipiṭaka*), Commentaries (*atthakathā*), Sub-commentaries (*tīkās*), Sub Sub-commentatires (*anutīkās*), Special Texts (*pakaraṇa-visesa*), etc. respectively by using the Pāli Text Society's Pāli version and English translation series. Then the secondary sources are explored by usage of Buddhist textbooks, research works, Doctor of Philosophy dissertations, journals, books, newspapers, including online sources, etc., among Pāli, Thai and English languages. In addition to those mentioned Buddhist side, from the biofeedback perspective, the primary and secondary sources from modern sciences such as physiological and psychological textbooks are explored in the same manner as Buddhism.

In addition to those abovementioned sources, the in-depth interviews are also conducted with eight key-informants from six countries around the world in which it has been already stated in the Chapter I, Topic 1.4.1 Scope of Sources of Data. Such information is specifically used in the Chapter IV where the analytical study is performed.

However the process of collecting, synthesizing, and utilizing the data may be understood depending on the response to each objective in the following ways:

3.4.1 Data Collection for Answering the First Objective

To explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH):

A collection of data from both primary and secondary sources of basic knowledge and the background of the two concepts from different Buddhist schools, namely:- (1) The concept of happiness access according to Buddhist principles in Theravāda Buddhist school, (2) The concept of Gross National Happiness (GNH) in Vajrayāna Buddhist school. The two abovementioned topics are appeared in the Buddhist scriptures both Theravāda and Vajrayāna. Apart from that is the

information obtained from the in-depth interviews is utilized as well in this step.

3.4.2 Data Collection for Answering the Second Objective

To examine the theory of biofeedback:

A collection of data from both primary and secondary sources of basic knowledge and the background of the theories relating to biofeedback is done in order to examine them in details. The information obtained from the in-depth interviews is utilized too here in this step.

3.4.3 Data Collection for Answering the Third Objective

To propose a conceptual model of bi-dimensional development for happiness access by biofeedback process:

A collection of data in order for answering to the third objective deals with re-utilizing some of those data that have been gathered earlier. The information obtained from the in-depth interviews is considered to be utilized as well in this step for the improvement of the model that the research team will present in the final phase.

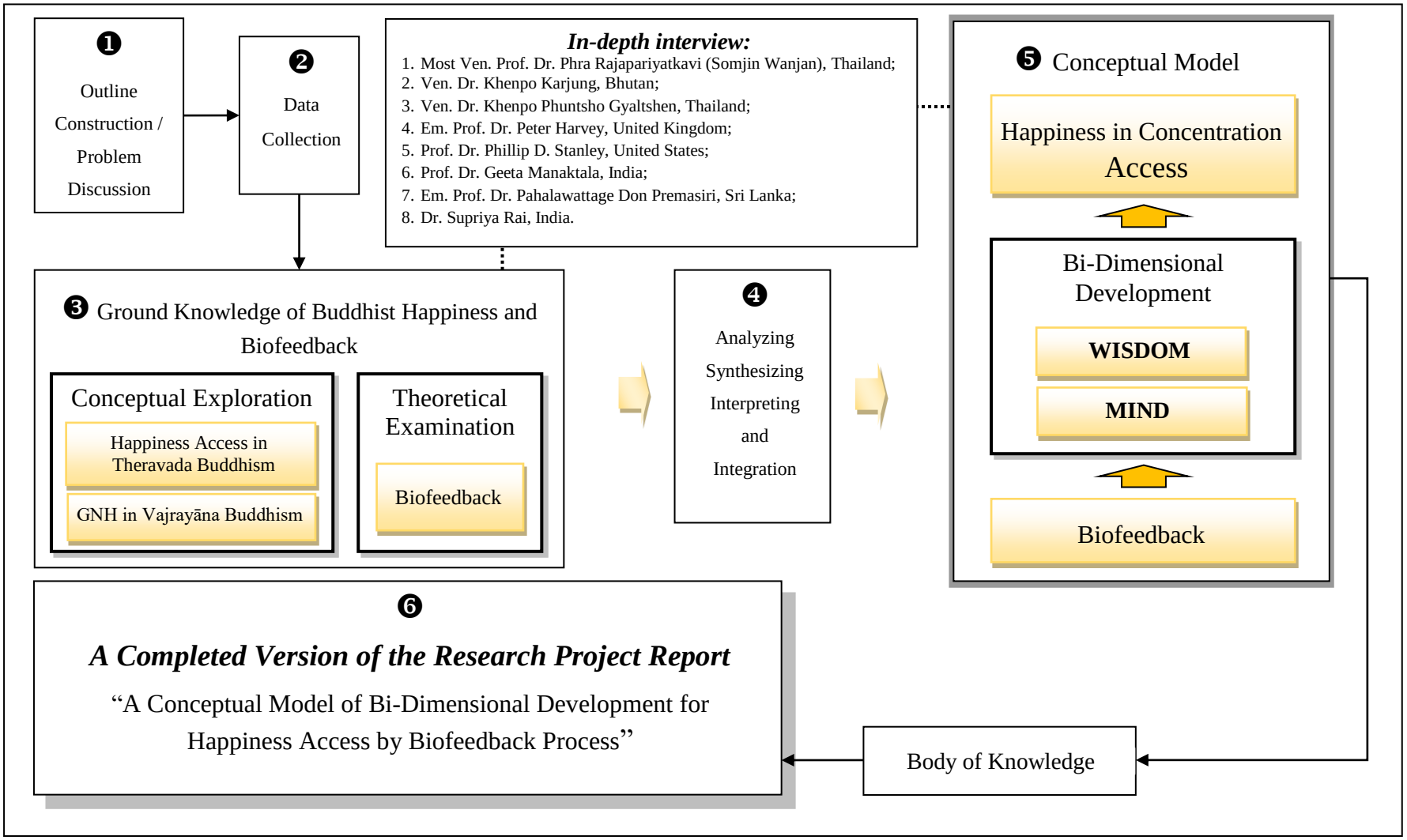
3.5 Data Analysis

An analysis of knowledge from scholars, psychologists, physiologists and Buddhist scholars to show the series of knowledge and the process gained from the study in organizations and universities. In addition, data analysis is also performed using qualitative analysis.

In addition to the data analysis, the data synthesis is to bring those results of analyzed data from various areas to be synthesized together. It is done by focusing on the importance of the concept and theory of knowledge creating as well as the proposal of a conceptual model of bi-dimensional development for happiness access by biofeedback process. Including the synthesis of knowledge by empirical methods based on Buddhism and modern sciences.

At this point, all of the details and information about the research methodology mentioned earlier can therefore be presented in the form of the Research Process Chart as follows:

Chart 3.1: The Research Process



Source: Asst. Prof. Dr. Sanu Mahatthanadull et al. 2020.

3.6 Summary of the Research Process[1]

In conducting the Research, there are stages in the research process conducted altogether respectively. The following six steps outline a summary of steps in the whole research process:

1) First Step: Outline Construction / Problem Discussion

The first step is outline construction which signifies constructing the overall outline of the work in all related dimensions corresponding to the objectives. Then the problem discussion, among the research team led by the research adviser, is made by discussing the problems encountered according to the significance of the studies. As a result, at this preliminary stage, the first outcome depicts a draft version of the research work together with the research's tentative table of content.

2) Second Step: Data Collection

The second step is preparation of data to be used in the research by gathering all useful data and information from various sources. This step has been mentioned in a detailed explanation earlier in the topic "Collection of Data" of this Chapter III.

3) Third Step: Creation of Ground Knowledge

Next, the third step represents the creation of ground knowledge of Buddhist happiness and biofeedback. This is the first attempt in creating a body of knowledge in a ground level using all useful materials from the previous step. As an outcome, the "ground knowledge" of the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH), mentioning in the first and second objectives of the study. These are an expectance of this step before it will be developed in the next order.

4) Fourth Step: Analysis, Synthesis, Interpretation, and Integration

[1] See Chart 3.1: The Research Process showing an overview of the entire process of how the research has been step-by-step conducted.

The fourth step deals mainly with those analytical studies together with synthesis and interpretation. They will be carried out carefully by using the ground level-knowledge obtained in the previous step.

5) Fifth Step: Development of Body of Knowledge

Then, the fifth step is developing body of knowledge from the ground level-knowledge. An analysis on such issue is to be carefully made using underlined concepts and theories drawing out from the ground knowledge, together with information obtained from the in-depth interviews. As an outcome, the "developed body of knowledge" of A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process, mentioning in the third objective, is a critical expectance of this step. The Step will end up with integration of the bodies of knowledge from Buddhism and biofeedback.

6) Sixth Step: Finalizing a Completed Version of the Research Project Report

Finally the last step is Finalizing a completed version of the research project report, starting by identifying significant research findings; compilation of bodies of knowledge and insights. Then it is formulating conclusions, conducting discussions, as well as suggesting useful information for possible further researches.

The final completed report entitled "A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process" is eventually developed and such body of knowledge is ready for its publication.

In other words, the research process may be presented alternatively in another way, using objectives as a determinant which resulting in 3 steps as follows:

Step 1: The Concept of Happiness Access according to Buddhist Principles and the Concept of Gross National Happiness (GNH)

1.1 Issues for Search:	1) Definitions and Types of Happiness according to Buddhist Principle 2) Practices of Happiness Access according to Buddhist Principle 3) Origin and development of GNH 4) Practices of GNH
1.2 Method:	Documentary study/In-depth interview
1.3 Data Sources:	Tipiṭaka/Commentaries/Sub-commentaries /Buddhist textbooks/Theses/Dissertations /Research works /Journals/ Specialists/Key-informants
1.4 Instruments:	Note papers/Voice recorder/In-depth interview forms
1.5 Data Collecting:	Read and conclusion/In-depth interview
1.6 Data Analysis:	Content analysis/Descriptive analysis

Step 2: The Theory of Biofeedback

2.1 Issues for Search:	1) Historical Perspective of Biofeedback 2) Meaning of Biofeedback 3) Ends of Biofeedback Process 4) Ways of Biofeedback Process 5) Means of Biofeedback Process
2.2 Method:	Documentary study/In-depth interview
2.3 Data Sources:	Tipiṭaka/Commentaries/Sub-commentaries/ Buddhist textbooks/texts of Biofeedback/ Theses/Dissertations/Research works/Journals/ Specialists/Key-informants
2.4 Instruments:	Note papers/Voice recorder/In-depth interview forms

2.5 Data Collecting: Read and conclusion/In-depth interview

2.6 Data Analysis: Content analysis/ Descriptive analysis

Step 3: Proposing A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process

3.1 Issues for Search: 1) Pre-Integration Information

2) Advantage and Restriction Analysis of the Buddhist Principles on the Happiness Access and GNH

3) Advantages and Restrictions Analysis of the Biofeedback Theory

4) A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process

3.2 Method: Documentary study/In-depth interview

3.3 Data Sources: Tipiṭaka/Commentaries/Sub-commentaries/ Buddhist textbooks/texts of Biofeedback/ Theses/Dissertations/Research works/Journals/ Specialists/Key-informants

3.4 Instruments: Note papers/Voice recorder/In-depth interview forms

3.5 Data Collecting: Read and conclusion/In-depth interview

3.6 Data Analysis: Content analysis/ Descriptive analysis/Model analysis

Chapter IV

Research Findings

In this chapter, the research team will discuss on the research findings are bodies of knowledge gained from the implementation of this research. The presentations in which is sequenced from the three objectives of the research, namely: - 1) to explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH), 2) to examine the theory of biofeedback, and 3) to propose a conceptual model of bi-dimensional development for happiness access by biofeedback process.

Therefore, the following issues will be presented as follows: - 1) Concept of Happiness Access according to Buddhist Principles and the Concept of Gross National Happiness (GNH), 2) Theory of Biofeedback, 3) A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process. The details are as follows.

4.1 Concept of Happiness Access according to Buddhist Principles and the Concept of Gross National Happiness (GNH)

In this topic, there are four designated issues to be studied, namely: - 1) Definitions and Types of Happiness according to Buddhist Principle, 2) Practices of Happiness Access according to Buddhist Principle, 3) Origin and Development of GNH, and 4) Practices of GNH. The details are as follow.

4.1.1 Definitions and Types of Happiness according to Buddhist Principle

Happiness is a significant term that probably be misled easily. Without correct understanding, one will never realize the true meaning of it. Therefore at this point, we will study happiness by the following two

issues, namely: - 1) Definitions of Happiness according to Buddhist Principle and 2) Types of Happiness According to Buddhist Principle.

a. Definitions of Happiness according to Buddhist Principle

The term "happiness" is an English word is literally translated from multiple Pāli terms, such as, *iṭṭha*,[1] *nibbuti*,[2] *pasīdana*,[3] *pāmujja*,[4] *pāmojja*,[5] *pīti,*[6] *bhagga*,[7] *vaḍḍhi*,[8] *vitti*,[9] *sampatti*,[10] *sampadā*,[11] *sampasādana*,[12] *sātatā*,[13] *siva*,[14] *sukha*,[15] *sugati*,[16] *suhatā*,[17] *seyya*,[18] *sokhya*,[19] *somanassa*.[20] Such these original Pāli terms, In other words, the term '*sukha*' can be literally translated as happiness[21] which refers to the

[1] D.I.245; M.I.85; S.IV.60, 158, 235.

[2] "*khemaṁ pariyessāmi nibbutiṁ*" - J.I.3.

[3] Ps.II.121.

[4] D.I.72, 196; S.III.134; A.III.21; Sn. 256; Nett. 29; DA.I.217.

[5] D.II.214; M.I.37, 98; S.I.203; Dh.376, 381; Ps.I.177; Dhs.9, 86; Miln.84; Vism.2, 107, 177; DhA.IV.111.

[6] Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., (Kandy: Buddhist Publication Society, 2010), Footnote No. 6, p. 82.

[7] "*akāsi bhaggaṁ ti garū ti Bhāgyavā*" - Vism.210.

[8] J.V.101; J.VI.330.

[9] A.III.78; J.IV.103; Kvu.484; Dhs.9.

[10] Opposite to *vipatti*, A.IV.26, 160; Vism.58, 232; DA.I.126.

[11] A.I.38; Pv.II.9.

[12] Bv.I.35.

[13] S.I.17.

[14] Sn.115, 478; S.IV.370.

[15] Vin.I.294; D.I.73; M.I.37; S.I.5; A.III.355; It.47; Dh.2; Sn. 67; Dhs. 10; DhsA. 117; PvA.207.

[16] Vin.II.162, 195; D.I.143; Pug.60; It.24, 77, 112; A.III.5, 205; Vism.427.

[17] J.III.158.

[18] Vin.I.33; D.I.184; Sn.427, 440; Dh.76, 100; J.II.44.

[19] Sn.61; J.V.205.

[20] D.I.3; M.I.85, 313; S.IV.232; A.II.69; Dh. 341; Sn. 67; Pug. 59; VbhA.73.

[21] K. R. Norman, **Pāli Literature including the Canonical Literature in Prakrit and Sanskrit of all the Hīnayāna Schools of Buddhism**, Ed. by Jan Gonda, Vol. VII., (Wiesbaden: Harrassowitz, 1983), p. 197.

idea of happiness of the world.[22] While "*sukho*" (adjective) literally means blest, happy, delightful or pleasant.[23]

Interestingly the term "happiness" may alternatively be translated from the original Pāli "*pīti*" which implies to happy-mindedness[24] in the context of the fivefold absorption, a pleasure of happiness [in the first and second absorption][25] or *pītisukha*[26]

Sukha can also refers to pleasant feeling of beings ". . . *tisso vedanā sukhā vedanā dukkhā vedanā adukkham-asukhā vedanā.*"[27] Three feelings: pleasant, painful, neither.[28]

Sukha may be appeared in the form of *sukhindriya*[29] as stated in the Indriyasaṃyutta "[bodily] pleasure faculty"[30]

The Buddha says in the Saṅgīti Sutta "*Aṭṭha loka-dhammā lābho ca alābho ca yaso ca ayaso ca nindā ca pasaṃsā ca sukhañ ca dukkhañ ca."* which is translated as "Eight worldly conditions (*loka-dhamma*): gain and loss, fame and shame, blame and praise, happiness and misery (*sukhañ ca dukkhañ ca)*"[31] Thus *sukha* is one of the states

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[22] Nyanatiloka, **Buddhist Dictionary: Manual of Buddhist Terms and Doctrines**, 4th Revised ed. by Nyanaponika, (Kandy: Buddhist Publication Society, 1980), p.123.

[23] Robert Caesar Childers, **A Dictionary of the Pāli Language**, (London: Trubner & Co., 1875), p. 487.

[24] Kaccāna Thera, **The Guide (Netti-Ppakaraṇaṃ)**, Tr. by Bhikkhu Ñāṇamoli, (London: PTS, 1977), p. 300.

[25] Op.cit.

[26] Ibid., p. 265.

[27] D.III.216.

[28] D.III.216; Maurice Walshe (tr.), **Thus Have I Heard: The Long Discourses of the Buddha (Dīgha Nikāya)**, (London: Wisdom Publications, 1987), p. 484.

[29] "*Pañcimāni bhikkhave indriyāni. katamāni pañca. Sukhindriyaṃ dukkhindriyaṃ somanassindriyaṃ domanassindriyaṃ upekkhindriyaṃ. Imāni kho bhikkhave pañcindriyānīti.*" - S.V.207.

[30] "Bhikkhus, there are these five faculties. What five? The pleasure faculty, the pain faculty, the joy faculty, the displeasure faculty, the equanimity faculty." - S.V.207; Bhikkhu Bodhi (tr.), **The Connected Discourses of the Buddha A New Translation of the Saṃyutta Nikāya**, Vol. II. 2 Vols. Set, (Oxford: PTS, 2000), p. 1679; see also in Vbh.122; Vism.491; Comp.175.

[31] D.III.260; Maurice Walshe (tr.), **Thus Have I Heard: The Long Discourses of the Buddha (Dīgha Nikāya)**, p. 505.

among the eight worldly states are gain, fame, praise, pleasure [*sukha*], and their opposites[32]

The Venerable Sāriputta, in the Book of the Gradual Sayings, responded to the Wanderer (*paribbājaka*) Sāmandakāni's quest that happiness arises from content (*sāta*):

> *. . . sukhaṃ sātaṃ nādhigacchati ṭhitopi. . . Nisinnopi. . . Sayānopi. . . Gāmagatopi. . . Araññagatopi. . . Rukkhamūlagatopi. . . Suññāgāragatopi. . . Abbhokāsagatopi. . . bhikkhumajjhagatopi sukhaṃ sātaṃ nādhigacchati anabhiratiyā āvuso.*[33]
>
> Where there is content, your reverence, this weal may be looked for: Whether one goes, stands, sits or lies, he reaches happiness and pleasure. Whether he has gone to the forest, to the root of a tree, to a lonely place, to a life in the open air or life amid the monks, he reaches happiness and pleasure. Where there is content, your reverence, this weal may be looked for.[34]

In Abhidhammatthasangaha stated one *citta* that is classified under a group of rootless resultant-of-morality consciousness (*kusalavipākaahetuka-citta*), named *sukhasahagataṃ kāyaviññānaṃ*[35] is Body-consciousness, accompanied by pleasure.[36] According to Phra Rajapariyatkavi (Somjin Wanjan)'s view, the mind is closely related to the function of the nervous system in Buddhist physiology:

> Mind or consciousness related to the human's nervous system. Sometimes mind is associated with anger, tension, etc. which are one of the fifty two mental factors (*cetasikas*). The mind is constantly

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[32] Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., pp. 506, 82, Footnote No. 13, p. 199.

[33] A.V.121.

[34] F. L. Woodward (tr.), **The Book of the Gradual Sayings (Aṅguttara-Nikāya)**, Vol. V (The Book of the Tens and Elevens), (London: Luzac & Company, Ltd., 1972), p. 83.

[35] Comp.81-93.

[36] Comp.81-93; Shwe Zan Aung, Mrs. Rhys Davids (trs.), **Compendium of Philosophy (Abhidhammattha Saṅgaha)**, (London: Luzac & Company, Ltd., 1972), p. 85.

working and has characters that can change, such as when the mind is angry or stressed causing the nervous system to be affected too.[37]

The psycho-physical life system consisting of mind and physical body affects each other. That is when the feelings, perceptions and mental formations have originated from the consciousness; they will then communicate the said message to the physical body in both good and bad ways. He further explains "Because signaling thoughts to the nervous system is for physical actions. If the signaling done with an unusual condition; it will cause a negative physical effect."[38] Happiness thus is the result of normal communication processes in human life. Ven. Khenpo Karjung's opinion is complies with the above sentence:

> Mind (*citta*) is the most important among others to root the happiness or suffering. The tears beneath happiness which we want to benefit everyone around the world. Everything can be done by mind which including happiness.[39]

Geeta Manaktala also views "Consciousness is the only identity of the humans. Mind is the most important element in the process of human beings."[40] Happiness or sufferings are all natural conditions created by our own mind. No one can coerce our hearts into happiness or sufferings but our own mind. In order to examine happiness in a deeper context, it is worth knowing that the opposite state of happiness (*sukha*) is suffering (*dukkha*) in which Bhadantacariya Buddhaghosa has expounded about its etymological definition:

> The word du ("bad") is met with in the sense of vile (*kucchita*); for they call a vile child a *du-putta* ("bad child"). The word *kham* ("-ness"), however is met with in the sense of empty (*tuccha*), for they

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[37] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

[38] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

[39] Interview with Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan, March 25, 2019.

[40] Interview with Prof. Dr. Geeta Manaktala, Panjab University, Chandigarh, India, Mar 25, 2019.

> call empty space "*kham*." And the first truth is vile because it is the haunt of many dangers, and it is empty because it is devoid of the lastingness, beauty, pleasure, and self-conceived by rash people. So it is called *dukkham* ("badness" = suffering, pain), because of vileness and emptiness.[41]

As pointed out in the Long Discourses of the Buddha (Dīgha Nikāya): ". . . *tisso dukkhatā dukkhadukkhatā saṅkhāradukkhatā vipariṇāmadukkhatā.*"[42] There are three aspects of *dukkha*: (1) *dukkha-dukkhatā*, which is ordinary suffering; (2) *vipariṇāma-dukkhatā*, which is suffering experienced by change; and (3) *saṅkhāra-dukkhatā*, which is suffering experienced by conditioned states.[43]

Bhikkhu Bodhi views the second aspect of suffering is *vipariṇāma dukkha* as:

> *Vipariṇāma* means "change." It is the nature of this universe that all things constantly change-they are impermanent by nature. Thus, a happy feeling or a happy condition cannot last. When they change, suffering, pain, or unpleasant feelings are the result. "Whatever is impermanent is suffering," said the Buddha. Whenever one is faced with worldly vicissitudes; one experiences suffering in life. The first two aspects of suffering are easy to understand since they are common experiences in daily life. Because these aspects of suffering are readily recognizable as general experiences, they have typically come to stand for the meaning of *dukkha* referred to in the First Noble Truth. However, this does not convey the full meaning of *dukkha* as the Buddha used the term when referring to the First Noble Truth.[44]

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[41] Vism. 495; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., Footnote No. 6, pp. 82, 506.

[42] D.III.216.

[43] D.III.216; Maurice Walshe (tr.), **Thus Have I Heard: The Long Discourses of the Buddha (Dīgha Nikāya)**, p. 484.

[44] Ācariya Anuruddha, **A Comprehensive Manual of Abhidhamma (The Abhidhammattha Saṅgaha)**, Gen. Ed. by Bhikkhu Bodhi, Revised and Ed. by Allan R. Bomhard, (Charleston: Buddhist Fellowship, 2007), p. 303.

Nibbāna, to the general understanding, is the death of an *arahant*. It's a special city, empty of pain and chock full of the happiness of fulfilled wishes.[45]

In conclusion, happiness is an English word is literally translated from multiple Pāli terms, such as, *iṭṭha*, *nibbuti*, *pasīdana*, *pāmujja*, *pāmojja*, *pīti*, *bhagga*, *vaḍḍhi*, *vitti*, *sampatti*, *sampadā*, *sampasādana*, *sātatā*, *siva*, *sukha*, *sugati*, *suhatā*, *seyya*, *sokhya*, *somanassa*. Especially the term "*sukha*" refers to the idea of happiness of the world. When it accompanies with physical body, it is called bodily happiness. And when it accompanies with mind, it is called mental happiness. Happiness (*sukha*) has suffering (*dukkha*) as the opposite state. While "*pīti*" implies happy-mindedness in the context of the fivefold absorption, is a pleasure of happiness [in the first and second absorption] or *pītisukha*. Nevertheless in this research, the happiness that is mentioned here will be a specific context of happiness in the dimension of the mental and wisdom development, for example, *pāmojja*, *pīti*, *sukha*, etc.

b. Types of Happiness According to Buddhist Principle

In this research there are two main categories of happiness. They are: - 1) Happiness in the Concentration, and 2) The Thirteen Dyads of Happiness in the Sukha-vagga.

1. Happiness in the Concentration[46]

One of the categories of happiness is classified as happiness in the concentration (*samādhi*). This is because practice of meditation makes mind comfortable, which is the result of concentration"[47] It is obvious that the concept of happiness in Buddhism appears meticulously in various forms depending on each context. There are five types of happiness in this particular context, namely: - Gladdening (*pāmojja*),

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[45] Buddhadāsa Bhikkhu, **Nibbāna for Everyone**, Tr. from the Thai by Santikaro, (Norwalk: Liberation Park, 2016), p. 1.

[46] This type of happiness is the one that will be discussed, analyzed, and integrated into the presenting Model again later in this Chapter IV, Topic 4.3.4 "A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process".

[47] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

Happiness (*pīti*), Tranquility (*passaddhi*), Bliss (*sukha*), and Concentration (*samādhi*). According to the seventh dyad of *Sīla-nidesa* of the Visuddhimagga, Bhadantacariya Buddhaghosa says the two types of virtue (*sīla*). All virtue subject to cankers is mundane (*lokiya-sīla*); that not subject to cankers is supra-mundane (*lokuttara-sīla*). Herein, the mundane brings about improvement in future becoming and is a prerequisite for the escape from becoming[48], according as it is said:

> *Vinayo saṃvaratthāya saṃvaro avippaṭisāratthāya avippaṭisāro pāmujjatthāya pāmujjaṃ pītatthāya pīti passaddhatthāya passaddhi sukhatthāya sukhaṃ samādhatthāya samādhi yathābhūtañāṇadassanatthāya yathābhūtañāṇadassanaṃ nibbidatthāya nibbidā virāgatthāya virāgo vimuttatthāya vimutti vimuttiñāṇadassanatthāya vimuttiñāṇadassanaṃ anupādāparinibbānatthāya.*[49]
>
> Discipline [*vinaya*] is for the purpose of restraint [*saṃvara*], restraint is for the purpose of nonremorse [*avippaṭisāra*], non-remorse is for the purpose of gladdening [*pāmojja*], gladdening is for the purpose of happiness [*pīti*], happiness is for the purpose of tranquility [*passaddhi*], tranquility is for the purpose of bliss [*sukha*], bliss is for the purpose of concentration [*samādhi*], concentration is for the purpose of correct knowledge and vision [*yathābuta-ñāṇadassana*], correct knowledge and vision is for the purpose of dispassion [*nibbidā*], dispassion is for the purpose of fading away (of greed) [*virāga*], fading away is for the purpose of deliverance [*vimutti*], deliverance is for the purpose of knowledge and vision of deliverance [*vimutti-ñāṇadassana*], knowledge and vision of deliverance is for the purpose of complete extinction (of craving) [*anupādā-parinibbāna*]. . .[50]

The fourteen elements can be easily drawn from the above passage ranging from discipline to the complete extinction of craving, as follows:

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[48] Vin.V.164; Vism.13; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., p. 16.

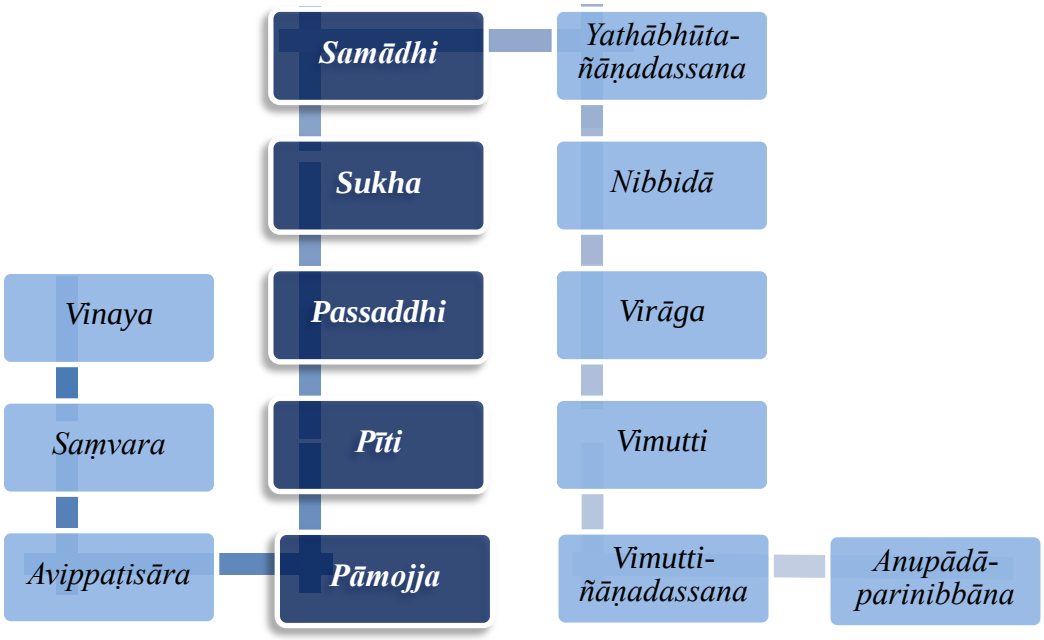
[49] Vin.V.164.

[50] Vin.V.164; Vism.13; Op.cit.

1. Discipline (*vinaya*)
2. Restraint (*saṃvara*)
3. Non-remorse (*avippaṭisāra*)
4. **Gladdening** (*pāmojja*)
5. **Happiness** (*pīti*)
6. **Tranquility** (*passaddhi*)
7. **Bliss** (*sukha*)
8. **Concentration** (*samādhi*)
9. Correct knowledge and vision (*yathābhūta-ñāṇadassana*)
10. Dispassion (*nibbidā*)
11. Fading away of greed (*virāga*)
12. Deliverance (*vimutti*)
13. Knowledge and vision of deliverance (*vimutti-ñāṇadassana*)
14. Complete extinction of craving (*anupādā-parinibbāna*).

It is noticeable that there are five kinds of state of happiness among them including concentration itself, namely: - *pāmojja*, *pīti*, *passaddhi*, *sukha*, and *samādhi*. Now in order to see the clearer phases of such elements, the next figure points out The Fivefold Happiness amid *Vinaya* and *Parinibbāna*:

Figure 4.1: The Fivefold Happiness amid *Vinaya* and *Parinibbāna*



Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

From the figure, there are five kinds of happiness, namely: - (1) Gladdening (*pāmojja*), (2) Happiness (*pīti*), (3) Tranquility (*passaddhi*), (4) Bliss (*sukha*), and (5) Concentration (*samādhi*)[51] which are located in the middle of the courses. The mental states of mind, as clustered together, the fivefold happiness is a fruit of non-remorse (*avippaṭisāra*) which arise from restraining (*saṃvara*) of the discipline (*vinaya*). It is noticeable that observing the *sīla* can also simply attain *sukha* as it is called happy habit *(sukha-sīla)*.[52] Phra Rajapariyatkavi (Somjin Wanjan) strongly agreed to the above statement. He also views that *sīla* plays a

[51] When the "concentration (*samādhi*)" and the 4 abovementioned constituents are gathered together, they are recognized as "Concentration of the Dhamma (*dhamma-samādhi*)" in which signifies the five kinds of virtue that make one to be firmness in the Dhamma. They are (1) Gladdening (*pāmojja*), Happiness (*pīti*), Tranquility (*passaddhi*), Bliss (*sukha*), and (5) Concentration (*samādhi*): "*Atha vā 'pāmojjaṃ jāyati, pamuditassa pīti jāyatī' ti evaṃ-vuttā-pāmojja-pīti-passaddhi-sukha-samādhi-saṅkhātā pañca dhammā dhamma-samādhi nāma*" - S.IV.350; SA.III.110.

[52] Vism. 14; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., p. 17.

crucial role in terms of being a stable foundation to the higher training such as concentration:

> The firm concentration originated from the stable precepts (*sīla*). The factors that cause concentration are non-anxiety, making mind full of happiness, delightful, and peace of mind. Therefore, when practicing meditation until the mind is concentrated, the practitioners will be happiness, delightful, peaceful, calm, not worried, causing relaxation and will affect the nervous system in a good way.[53]

His View shows that the basic happiness obtained from *sīla*-observance is a solid foundation of the happiness attained within concentration practice. And eventually the happy mind effectively reacts to the human nervous system. However, the said five kinds of happiness sustainably maintain the level of concentration (*samādhi*) where they are recognized as "The Fivefold Happiness". Such process is in order for obtaining a correct knowledge and vision (*yathābhūta-ñāṇadassana*). And when one gets this kind of knowledge and vision, one can penetrate seeing things by wisdom. Then the dispassion (*nibbidā*) will arise at one's mind together with fading away of greed (*viraga*). This is the point where deliverance (*vimutti*) is originated following by knowledge and vision of deliverance (*vimutti-ñāṇadassana*). Eventually the complete extinction of craving (*anupādā-parinibbāna*) is attained at the last phase.

At the 2nd kind of happiness, the Fivefold Happiness (*pīti*)[54], Bhadantacariya Buddhaghosa has expounded the five different kinds of *pīti* in The Path of Purification.

(1) Minor Happiness (*khuddakā-pīti*)

Minor happiness is only able to raise the hairs on the body.

(2) Momentary Happiness (*khaṇikā-pīti*)

Momentary happiness is like flashes of lightning at different moments.

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[53] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

[54] Vism.143-144; Ibid., pp. 137-138.

(3) Showering Happiness (*okkantikā-pīti*)

Showering happiness breaks over the body again and again like waves on the sea shore.

(4) Uplifting Happiness (*ubbegā-pīti*)

Uplifting happiness can be powerful enough to levitate the body and make it spring up into the air.

(5) Pervading (rapturous) Happiness (*pharaṇā-pīti*)

When pervading (rapturous) happiness arises, the whole body is completely pervaded, like a filled bladder, like a rock cavern invaded by a huge inundation.

The above mind-produced *pīti* is so phenomenal. Each type of them has unique characteristics and different functions which vary according to the power levels of concentration. These five types of *pīti* can create astonishing phenomena to the physiological activities of human beings.

What is interesting is that some specific types of *pīti* are also directly related to supernatural phenomena. For instance, *ubbegā-pīti* is the happiness that can make the absolute levitation of the body to rise above the ground. This kind of happiness creates a special phenomenon that is against any laws of physics, laws of gravity, laws of physics, for instance including all other scientific laws available today. Besides, they also challenged other kinds of worldly laws of nature towards the ordinary thinking system of humans.

The earlier aforementioned fivefold *pīti*, as stated in the Visuddhimagga, when is saturated, can lead to the achievement of the twofold tranquility both bodily tranquility (*kāyika-passaddhi*) and mental tranquility (*kāyika-passaddhi*). They further lead to the twofold bliss either, namely bodily bliss (*kāyika-sukha*) and mental bliss (*cetasika-sukha*) as a result.

Sukha is usually translated as pleasure or bliss. Pleasing (*sukhana*) is bliss (*sukha*). It has gratifying as its characteristic. Its

function is to intensify associated states. It is manifested as aid.[55] And wherever the two are associated, happiness (*pīti*) is the contentedness at getting a desirable object [*iṭṭhārammaṇa*], and bliss (*sukha*) is the actual experiencing of it when got. Where there is *pīti* there is *sukha*; but where there is *sukha* there is not necessarily *pīti*. *Pīti* is included in the formations aggregate; *sukha* is included in the feeling aggregate. If a man, exhausted in a desert, saw or heard about a pond on the edge of a wood, he would have *pīti*; if he went into the wood's shade and used the water, he would have *sukha*. And it should be understood that this is said because they are obvious on such occasions.[56] When having the threefold concentration (*samādhi*) as a resultant, Bhadantacariya Buddhaghosa implies:

> Now, this fivefold happiness, when conceived and matured, perfects the twofold tranquility [*passaddhi*], that is, bodily and mental tranquility. When tranquility is conceived and matured, it perfects the twofold bliss, that is, bodily and mental bliss. When bliss is conceived and matured, it perfects the threefold concentration, that is, momentary concentration (*khaṇika-samādhi)*, access concentration (*upacāra-samādhi*), and absorption concentration (*appanā-samādhi*).[57]

From the above statement, it can be best clarified the significant relationship among the fivefold *pīti*, the twofold *passaddhi*, the twofold *sukha* and the threefold *samādhi* as in the following figure:

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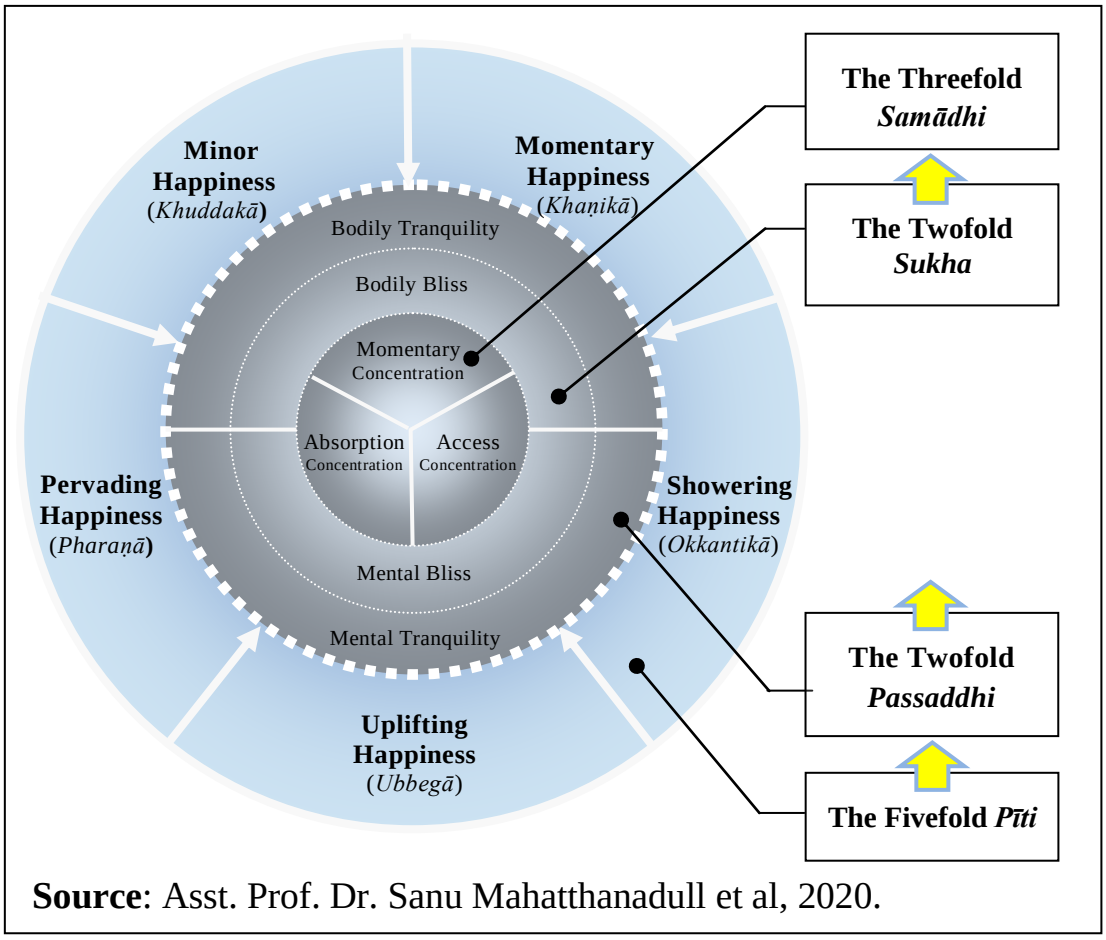
[55] Vism.145; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., p. 139.

[56] Vism.145; Op.cit.

[57] Vism.144; Ibid., p. 138.

Figure 4.2: Causal Relationship among the *Pīti, Passaddhi, Sukha* and *Samādhi*



Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

In an effort to study the concept of absorptions through the two key Pāli terms "***pīti***" and "***sukha***", there is some problem in terms of translation. That is, there is a fact about the difficulties in studying of Buddhism through English language which is required for deeper understanding. Especially the rendering into English from the original Pāli may easily cause misunderstandings to the learners. This is because there are a lot of Pāli technical terms in which each single term may be translated into multiple choices in the other languages, the English in particular. In addition to that reason, it is also due to the inconsistency of the translated terms and the limit of translated languages. In this case, the translation of many Pāli words, such as the two forms of happiness that appeared in the concept of the absorptions, namely: - "*pīti*", "*sukha*", which may be interpreted in many ways depending on the rationale of

each translator, for example, they may be translated as pleasure, bliss, cheerfulness, gladness, joy, rapture, elation, zest, happiness, etc.

Nevertheless, the Buddha says, in the Mahāsatipaṭṭhāna Sutta, about the Four ***jhānas*** as the right concentration:

Katamo ca bhikkhave sammā-samādhi?

Idha bhikkhave bhikkhu vivicceva kāmehi vivicca akusalehi dhammehi savitakkaṃ savicāraṃ vivekajaṃ pīti-sukhaṃ paṭhamajjhānaṃ upasampajja viharati.

Vitakka-vicārānaṃ vūpasamā ajjhattaṃ sampasādanaṃ cetaso ekodi-bhāvaṃ avitakkaṃ avicāraṃ samādhijaṃ pīti-sukhaṃ dutiyajjhānaṃ upasampajja viharati.

Pītiyā ca virago upekhako viharati sato ca sampajāno, sukhaṃ ca kāyena patisaṃvedeti yan taṃ ariyā ācikkhanti: upekhako satimā sukha-vihārī ti tatiyajjhānaṃ upasampajja viharati.

Sukhassa ca pahānā dukkhassa ca pahānā pubbe va somanassa-domanassānaṃ atthaṅgamā adukkhaṃ asukhaṃ upekkhā-sati-pārisuddhiṃ catutthajjhānaṃ upasampajja viharati. Ayaṃ vuccati bhikkhave sammā-samādhi.[58]

And what, monks, is Right Concentration**?**

Here, a monk, detached from sense-desires, detached from unwholesome mental states, enters and remains in the **first *jhāna***, which is with thinking [*vitakka*] and pondering [*vicāra*], born of detachment, filled with delight [*piti*] and joy [*sukha*].

And with the subsiding of thinking and pondering, by gaining inner tranquility and oneness of mind [*ekodi-bhāvaṃ*], he enters and remains in the **second *jhāna***, which is without thinking and pondering, born of concentration, filled with delight and joy.

And with the fading away of delight, remaining imperturbable, mindful and clearly aware, he experiences in himself the joy of which the Noble Ones say: “Happy is he who dwells with equanimity [*upekkhā*] and mindfulness”, he enters the **third *jhāna***.

[58] D.II.313.

> And, having given up pleasure and pain, and with the disappearance of former gladness and sadness, he enters and remains in the **fourth *jhāna***, which is beyond pleasure and pain, and purified by equanimity and mindfulness.[59]

From the above passage, the first *jhāna* is called the *pañcaṁgika-jhāna* as T.W. Rhys Davids and William Stede says "The Vibhaṅga calls the first *jhāna* the *pañcaṁgika-jhāna* because it, by itself, can be divided into five parts"[60] Caroline A. F. Rhys Davids notes that *Jhāna* is usually alluded to in the Pitakas in the fourfold order. The fivefold division is obtained by the successive, instead of simultaneous, elimination of *vitakko* and *vicāro*.[61] The Dhammasaṅgaṅī makes a second list of five stages, by calling, in the second *jhāna*, the fading away of observation (*vitakka*) one stage, and the giving up of sustained thinking (*vicāra*) another stage.[62]

It should be noted here about the Four *jhānas* that is explained in the Visuddhimagga:

> In the third tetrad the first *jhāna* has five factors, that is to say, applied thought [*vitakka*], sustained thought [*vicāra*], happiness [*piti*], bliss [*sukha*], and concentration [*samādhī*], following suppression of the hindrances. The second has the three factors remaining after the elimination of applied and sustained thought. The third has two factors with the fading away of happiness. The fourth, where bliss is abandoned, has two factors with concentration and the equanimous feeling [*upekkhā*] that accompanies it. Thus there are four kinds of

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[59] D.II.313; Maurice Walshe (tr.), **Thus Have I Heard: The Long Discourses of the Buddha (Dīgha Nikāya)**, p. 349.

[60] T.W. Rhys Davids and William Stede (eds.), **The Pāli Text Society's Pāli-English Dictionary**, Part IV (Cit-No), 8 Vols. Set, (London: PTS, 1923), p. 120; *"pañcaṅgikaṃ jhānaṃ hoti vitakko vicāro pīti sukhaṃ cittassa ekaggatā"* - Vbh 267.

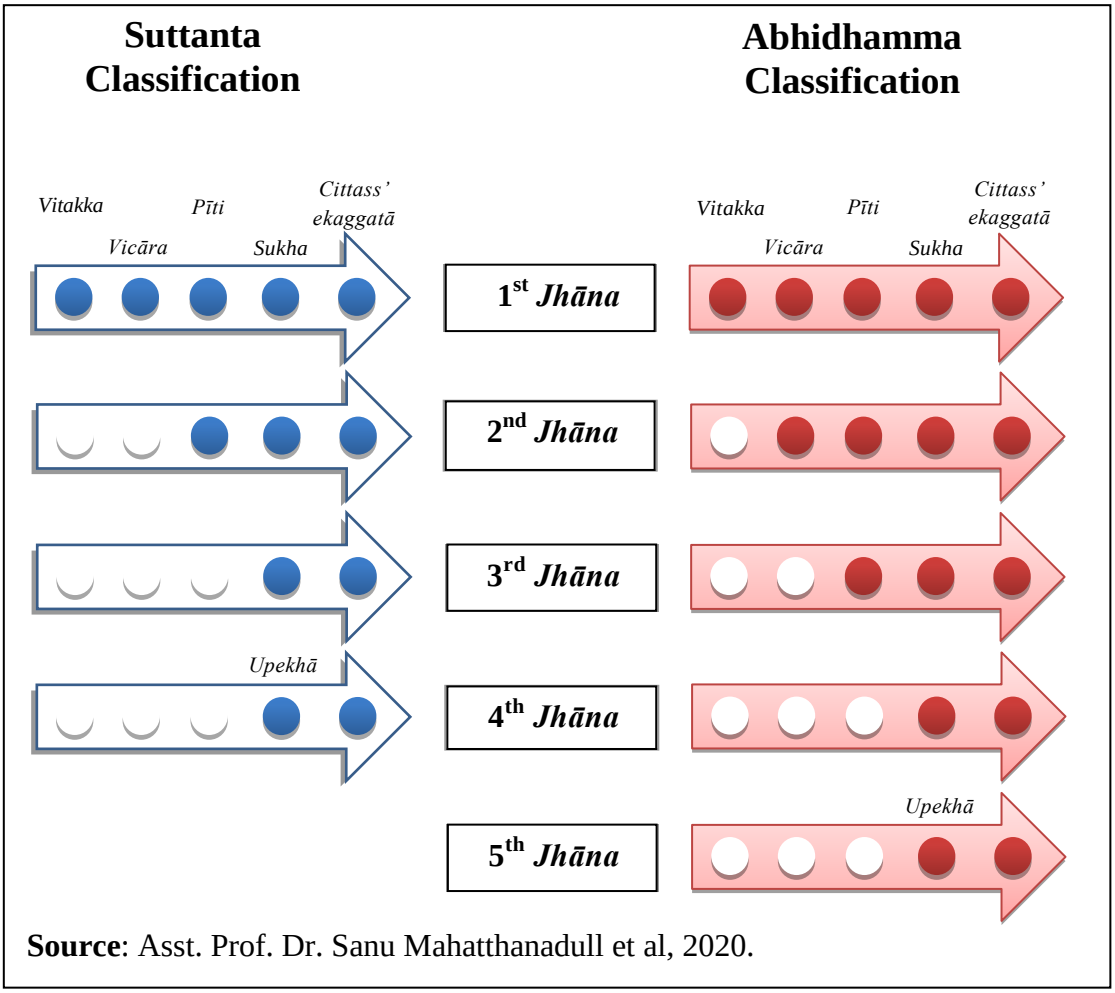
[61] Caroline A. F. Rhys Davids (tr.), **A Buddhist Manual of Psychological Ethics (Dhamma-Saṅgaṇī)**, (London: Royal Asiatic Society, 1900), Footnote No.1, p. 52.

[62] Dhs. 167-175; T.W. Rhys Davids and William Stede (eds.), **The Pāli Text Society's Pāli-English Dictionary**, Part IV (Cit-No), 8 Vols. Set, p. 120.

concentration according to the factors of these four *jhānas*. So it is of four kinds according to the factors of the four *jhānas*.[63]

From the abovementioned evidences, the *jhānas* consist of numbers of factors and can be appeared in both Suttanta' the four *jhānas* and Abhidhamma' the five *jhānas*. They are listed in the figure below:

Figure 4.3: The Four and the Five *Jhānas* based on the Classifications of Suttanta and Abhidhamma



Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

[63] "*vitakka-vicāra-piti-sukha-samādhīnaṃ*" - Vism.88; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., p. 85.

Thus the *pañca-jhāna* comprises of *vitakka, vicāra, pīti, sukha* and *cittass' ekaggatā.*[64] And it is also worth noting here, based on the exposition in the Dhamma-Saṅgaṇī, that *citt' ekaggatā* [*ekodi-bhāvaṃ*] refers to *samādhi*. "*citt' ekaggatā*, the one-peaked condition of mind, is a name for concentration (*samādhi*)."[65] The statement is in conformity with what is said by the commentator in the Atthasālinī: "*Cittassa ekagga-bhāvo cittekaggatā, samādhiss' etaṃ nāma.*"[66]

Just as mentioned earlier, the way of rendering may be varied depending on each translator. Herein, Maurice Walshe, the translator of this presented version of Dīgha Nikāya, preferably used the following English terms for his translation: thinking (*vitakka*); pondering (*vicāra*); delight (*piti*); joy (*sukha*); oneness of mind [*ekodi-bhāvaṃ*]; and equanimity (*upekkhā*). In the meantime though another translation work of the same text (Dīgha Nikāya) by T.W. and C.A.F. Rhys Davids, they used preferably the terms on those *jhāna* factors respectively: cogitation; deliberation; joy; ease; self-evoked [mind]; and equanimity[67] In addition to the Sutta, the first Abhidhamma Pitaka scripture named Dhamma-Saṅgaṇī evidenced: conception; discursive thought; joy; ease; self-collectedness; and equanimity.[68] While Paṭhamakyaw Ashin Thiṭṭila (Seṭṭhila) Aggamahāpaṇḍita has presented in order the following terms in the Vibhaṅga: initial application; sustained application; zest; pleasure; one-pointedness of consciousness; and equanimity.[69]

On the contrary, Bhikkhu Ñāṇamoli, the translator of the Buddhaghosa's Visuddhimagga, did his remarkable translation using the

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[64] Dhs 9, 83; Vbh.257; T.W. Rhys Davids and William Stede (eds.), **The Pāli Text Society's Pāli-English Dictionary**, Part V (P-Ph.), 8 Vols. Set, (London: PTS, 1923), p. 11.

[65] Caroline A. F. Rhys Davids (tr.), **A Buddhist Manual of Psychological Ethics (Dhamma-Saṅgaṇī)**, Footnote No.1, p. 13.

[66] DhsA. 118.

[67] D.II.313; T.W. and C.A.F. Rhys Davids (trs.), **Dialogues of the Buddha Translated from the Pāli of the Dīgha Nikāya**, Part II, (London: Oxford University Press, 1910), pp. 343-345.

[68] Dhs. 9; Caroline A. F. Rhys Davids (tr.), **A Buddhist Manual of Psychological Ethics (Dhamma-Saṅgaṇī)**, p. 3.

[69] Vbh. 257, 259; Paṭhamakyaw Ashin Thiṭṭila (Seṭṭhila) Aggamahāpaṇḍita (tr.), **The Book of Analysis (Vibhaṅga)**, (Oxford: PTS, 1995), pp. 335, 338.

following sequences respectively: applied thought; sustained thought; happiness; pleasure or bliss; unification; and equanimity.[70]

At this point of the study, there are at least five distinct versions of the translation which exhibits the difficulties in exploring Buddhist scriptures through translation of the second language. The following table points out the differences of the above mentioned expressions.

[70] Vism.84, 142-143, 145, 160; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., pp. 81, 136-137, 139, 152.

Table 4.1: Comparison among Different Translations of the *Jhāna* Factors[71]

	Original Pāli	English Translation				
	Dīgha Nikāya	**Dīgha Nikāya**		**Dhammasaṅgaṅī**	**Vibhaṅga**	**Visuddhimagga**
		Maurice Walshe	T.W. and C.A.F. Rhys Davids	Caroline A. F. Rhys Davids	Paṭhamakyaw Ashin Thiṭṭila	Bhikkhu Ñāṇamoli
1.	*vitakka*	thinking	cogitation	conception	initial application	applied thought
2.	*vicāra*	pondering	deliberation	discursive thought	sustained application	sustained thought
3.	*pīti*	delight	joy	Joy	zest	happiness
4.	*sukha*	joy	ease	ease	pleasure	pleasure / bliss
5.	*ekodi-bhāvaṃ*	oneness of mind	Self-evoked	self-collectedness[72]	one-pointedness of consciousness[73]	unification
6.	*upekkhā*	equanimity	equanimity	equanimity	equanimity	equanimity

Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

[71] The *Jhāna* Factors listed here are taken from the concept of *pañca-jhāna* factors as expounded in the two main Abhidhamma scriptures, namely: -

(1) Dhammasaṅgaṅī - "*vitakko hoti vicāro hoti pīti hoti sukhaṃ hoti cittass' ekaggatā. . .* " - Dhs. 9; Caroline A. F. Rhys Davids (tr.), **A Buddhist Manual of Psychological Ethics (Dhamma-Saṅgaṇī)**, p. 3; see T.W. Rhys Davids and William Stede (eds.), **The Pāli Text Society's Pāli-English Dictionary**, Part V (P-Ph.), 8 Vols. Set, p. 11.

(2) Vibhaṅga - "*Jhānan ti: vitakko vicāro pītisukhaṃ cittassa ekaggatā.*" - Vbh.257; Paṭhamakyaw Ashin Thiṭṭila (Seṭṭhila) Aggamahāpaṇḍita (tr.), **The Book of Analysis (Vibhaṅga)**, p. 335.

[72] "*cittass' ekaggatā.*" - Dhs. 9.

[73] "*cittassa ekaggatā.*" - Vbh.257.

From the table, there is no discrepancy in rendering *"upekkhā"*. But seems there are some seriously confusion in translation of the rest of the Pāli terms as there is no such translator who translated using the exact terms. They each used different English words.

However, to this point of possible confusion, Bhikkhu Ñāṇamoli has attempted to explain some reasons for using those words in his translation of the Pāli terms *pīti* and *sukha*:

> In loose usage *pīti* (happiness) and *sukha* (pleasure or bliss) are almost synonyms. They become differentiated in the *jhāna* formulas, and then technically *pīti,* as the active thrill of rapture, is classed under the formations aggregate and *sukha* under the feeling aggregate. The valuable word "happiness" was chosen for *pīti* rather than the possible alternatives of "joy" (needed for *somanassa),* "interest" (which is too flat), "rapture" (which is overcharged), or "zest." For *sukha,* while "pleasure" seemed to fit admirably where ordinary pleasant feeling is intended, another, less crass, word seemed necessary for the refined pleasant feeling of *jhāna* and the "bliss" of *Nibbāna* (which is not feeling aggregate)[74]. "Ease" is sometimes used.[75]

In addition to happiness and bliss, since it refreshes (*pīnayati*), thus it is happiness (*pīti*). It has the characteristic of endearing (*sampiyāyanā*). Its function is to refresh the body and the mind; or its function is to pervade (thrill with rapture). It is manifested as elation. But it is of five kinds in which the researchers will further clarify them.

2. The Thirteen Dyads of Happiness in the Sukha-vagga

Apart from the said 1st Category of happiness, there is another category of happiness elaborated in the Sukha-vagga. As Venerable Sāriputta, when he was staying among the Magadhese at Nālakagāmaka[76], once said happiness is gained from non-rebirth "Where

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[74] See M.I.400.

[75] Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., Footnote No. 6, p. 82.

[76] Nālakagāmaka refers to the name of the village not far from Rājagaha where the Venerable Sāriputta was born.

there is no rebirth this weal may be looked for: No cold and heat; no hunger and thirst; no evacuation and urination; no contact with fire, rod and spear; nor do one's friends abuse one when they meet or gather together. Where there is not rebirth, your reverence, this woe is not to be looked for"[77]

In the Sukha-vagga[78], the Buddha expounds 14 different pairs of happiness (*sukha*):

1. Pleasure of home (*gihi-sukha*), and pleasure of home-leaving (*pabbajjā-sukha*).

Of these two pleasures, that of home-leaving has the pre-eminence.

2. Pleasure of Sensuality (*kāma-sukha*)[79], and pleasure of renunciation (*nekkhamma-sukha*).[80]

Of these two pleasures, that of renunciation has the pre-eminence.

3. Pleasure of clinging to rebirth (*upadhi-sukha*)[81], and pleasure of not clinging to rebirth (*nirupadhi-sukha*).[82]

Of these two pleasures, that of not clinging to rebirth has the pre-eminence.

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[77] A.V.121; F. L. Woodward (tr.), **The Book of the Gradual Sayings (Aṅguttara-Nikāya)**, Vol. V (The Book of the Tens and Elevens), pp. 82-83.

[78] A.I.80; F. L. Woodward (tr.), **The Book of the Gradual Sayings (Aṅguttara-Nikāya)**, Vol. I (Ones, Twos, Threes), (London: PTS, 1979), p. 74.

[79] *Kāma-sukha* refers to pleasure is caused by relying on the five sensual pleasures; pleasurable form, sound, odor, taste, and tangible object. *"Dutiye kāmasukhan ti kāme ārabbha uppajjanakasukhaṃ."* AA.II.152.

[80] *Nekkhamma-sukha* means pleasure is caused by ordination. *". . . nekkhammasukhan ti nekkhammaṃ vuccati pabbajjā, taṃ ārabbha uppajjanakasukhaṃ."*AA.II.152.

[81] *Upadhi-sukha* refers to a mundane level of pleasure is mingled with defilements that cling to the three planes of existence (*kāmāvacara-bhūmi*, *rūpāvacara-bhūmi*, and *arūpāvacara-bhūmi*). "*Tatiye upadhisukhan ti tebhūmikasukhaṃ."* AA.II.153.

[82] *Nirupadhi-sukha* refers to a supramundane level of pleasure that is not mingled with defilements. *". . . nirupadhisukhan ti lokuttarasukhaṃ.*" AA.II.153.

4. Pleasure which attends the *āsavas* (*āsava-sukha*)[83], and pleasure which attends freedom from the *āsavas* (*ānāsava-sukha*).[84]

Of these two pleasures, which attends freedom from the *āsavas* has the pre-eminence.

5. Pleasure of Carnal (*sāmisa-sukha*)[85], and pleasure of non-carnal (*nirāmisa-sukha*).[86]

Of these two pleasures, that of non-carnal has the pre-eminence.

6. Pleasure of Ariyan (*ariya-sukha*)[87], and pleasure of non-Ariyan (*anariya-sukha*).[88]

Of these two pleasures, that of Ariyan has the pre-eminence.

7. Pleasure of bodily (*kāyika-sukha*)[89], and pleasure of mental (*cetasika-sukha*).[90]

Of these two pleasures, that of mental has the pre-eminence.

8. Pleasure with zest (*pīti-sukha*)[91], and pleasure without zest (*nippīti-sukha*).[92]

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[83] *Āsava-sukha* means pleasure associated in the round of existence in which conditioned to canker. *"Catutthe sāsavasukhan ti āsavānaṃ paccayabhūtaṃ vaṭṭasukhaṃ."* AA.II.153.

[84] *Ānāsava-sukha* means pleasure not associated in the round of existence in which unconditioned to canker. *"anāsavasukhan ti tesaṃ apaccayabhūtaṃ vivaṭṭasukhaṃ."* AA.II.153.

[85] *Sāmisa-sukha* refers to pleasure which requires defilement causing beings in the round of existence. *"Pañcame sāmisen ti saṅkilesaṃ vaṭṭagāmisukhaṃ."* AA.II.153.

[86] *Nirāmisa-sukha* refers to pleasure which requires no defilement. It causes beings free from the round of existence. *". . . nirāmisan ti nikkilesaṃ vivaṭṭagāmisukhaṃ."* AA.II.153.

[87] *Ariya-sukha* means pleasure that is not of the worldlings but of the noble individuals. *"Chaṭṭhe ariyasukhan ti aputhujjanasukhaṃ."* AA.II.153.

[88] *Anariya-sukha* means pleasure that is of the worldlings but is not of the noble individuals. *". . . anariyasukhan ti puthujjanasukhaṃ."* AA.II.153.

[89] *Kāyika-sukha* refers to pleasure that is born simultaneously with body-consciousness. *"Sattame kāyikan ti kāyaviññāṇasahajātaṃ."* AA.II.153.

[90] *Cetasika-sukha* refers to pleasure that is experienced through the mind-door. *". . . cetasikan ti manodvārikasukhaṃ."* AA.II.153.

[91] *Pīti-sukha* refers to pleasure that is experienced in the first and the second absorptions. *"Aṭṭhame sappītikan ti paṭhamadutiyajjhānasukhaṃ."* AA.II.153.

Of these two pleasures, without zest has the pre-eminence.

9. Pleasure of delight (*sāta-sukha*)[93], and pleasure of indifference (*upekkhā-sukha*).[94]

Of these two pleasures, of indifference has the pre-eminence.

10. Pleasure of musing concentration (*samādhi-sukha*)[95], and pleasure without musing concentration (*asamādhi-sukha*).[96]

Of these two pleasures, of musing concentration has the pre-eminence.

11. Pleasure of an object of meditation which arouses zest (*sappītikārammaṇañ-sukha*)[97], and pleasure of an object of meditation which does not arouses zest (*nippītikārammaṇañ-sukha*).[98]

Of these two pleasures, of an object of meditation which does not arouses zest has the pre-eminence.

12. Pleasure in an object which causes delight (*sātārammaṇañ-sukha*), and pleasure in an object that causes indifference (*upekkhārammaṇañ-sukha*).

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[92] *Nippīti-sukha* refers to pleasure that is experienced in the third and the fourth absorptions. *". . . nippītikanti tatiyacatutthaj-jhānasukhaṃ."* AA.II.153.

[93] *Sāta-sukha* means pleasure in the three absorptions (*paṭhama-jhāna, dutiya-jhāna and tatiya-jhāna*). *"Navame sātasukhan ti tīsu jhānesu sukhaṃ."* AA.II.153.

[94] *Upekkhā-sukha* means pleasure in the fourth absorption. *". . . upekkhāsukhan ti catutthajjhānasukhaṃ."* AA.II.153.

[95] *Samādhi-sukha* refers to pleasure is at the point of access concentration and attainment concentration. *"Dasame samādhisukhan ti appanaṃ vā upacāraṃ vā pattasukhaṃ."* AA.II.153.

[96] *Asamādhi-sukha* refers to pleasure is not yet at the point of access concentration and attainment concentration. *". . . asamādhisukhanti tad-ubhayaṃ appattasukhaṃ."* AA.II.153.

[97] *Sappītikārammaṇañ-sukha* means pleasure is caused by reviewing of the second absorption having zest as a contemplating object. *"Ekādasame sappītikārammaṇan ti sappītikaṃ jhānadvayaṃ paccavekkhantassa uppannasukhaṃ."* AA.II.153.

[98] *Nippītikārammaṇañ-sukha* means pleasure is caused by reviewing of the second absorption not having zest as a contemplating object. *". . . nippītikārammaṇepi eseva nayo."* AA.II.153.

Of these two pleasures, in an object that causes indifference has the pre-eminence.

13. Pleasure of having a visible object for meditation (*rūpārammaṇañ-sukha*)[99], and pleasure of having the formless for object of meditation (*arūpārammaṇañ-sukha*).[100]

Of these two, the latter has the pre-eminence.

Such these happiness that have been classified in a multidimensional and comprehensive way from home happiness to happiness in concentration, then eventually to the happiness of the noble people. They are exhibited in the following table named "The Thirteen Dyads of *sukha* based on Sukha-vagga".

[99] *Rūpārammaṇañ-sukha* refers to pleasure that is caused by relying on the form sphere in the fourth absorption as a contemplating object. *"Terasame rūpārammaṇan ti rūpāvacaracatutthajjhānārammaṇaṃ, yaṅ kiñci rūpaṃ ārabbha uppajjanakaṃ vā."* AA.II.153.

[100] *Arūpārammaṇañ-sukha* refers to pleasure that is caused by relying on the formless sphere in the fourth absorption as a contemplating object. *". . . rūpārammaṇan ti arūpāvacarajjhānārammaṇaṃ, yaṅ kiñci arūpaṃ ārabbha uppajjanakaṃ vā ti."* AA.II.153.

Table 4.2: The Thirteen Dyads of *sukha* based on Sukha-vagga[101]
Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

Dyad		**Pleasure** (*sukha*)		
1.	×	Home (*gihi-sukha*)	✓	Home-leaving (*pabbajjā-sukha*)
2.	×	Sensuality (*kāma-sukha*)	✓	Renunciation (*nekkhamma-sukha*)
3.	×	Clinging to rebirth (*upadhi-sukha*)	✓	Not clinging to rebirth (*nirupadhi-sukha*)
4.	×	Attends the *āsavas* (*āsava-sukha*)	✓	Attends freedom from the *āsavas* (*ānāsava-sukha*)
5.	×	Carnal (*sāmisa-sukha*)	✓	Non-carnal (*nirāmisa-sukha*)
6.	✓	Ariyan (*ariya-sukha*)	×	Non-Ariyan (*anariya-sukha*)
7.	×	Bodily (*kāyika-sukha*)	✓	Mental (*cetasika-sukha*)
8.	×	With zest (*pīti-sukha*)	✓	Without zest (*nippīti-sukha*)
9.	×	Delight (*sāta-sukha*)	✓	Indifference (*epekkhā-sukha*)
10.	✓	Musing concentration (*samādhi-sukha*)	×	Without musing concentration (*asamādhi-sukha*)
11.	×	Object of meditation which arouses zest (*sappītikārammaṇañ-sukha*)	✓	Object of meditation which does not arouses zest (*nippītikārammaṇañ-sukha*)
12.	×	Object which causes delight (*sātārammaṇañ-sukha*)	✓	Object that causes indifference (*upekkhārammaṇañ-sukha*)
13.	×	Visible object for meditation (*rūpārammaṇañ-sukha*)	✓	Formless for object of meditation (*arūpārammaṇañ-sukha*)

Note: The symbol ✓ represents the superior pleasure, while the symbol × marks the inferior pleasure.

The above table is divided into two columns. The left-side column shows each type of happiness. While the right-side column shows happiness in contrast to the left side. For example, Home-leaving happiness is in contrast to Home happiness. As for the rows, they represent the thirteen different classifications of happiness, from Home-happiness to Visible-object-for-meditation happiness. Lastly, the check signs (✓) represent the pleasure that are superior, while the cross signs (×) mark the pleasure that are inferior.

From the table, the first pair of *sukha* called *gihi sukha "Cattārīmāni gahapati sukhāni adhigamanīyāni gihinā kāmabhoginā*

[101] A.I.80; F. L. Woodward (tr.), **The Book of the Gradual Sayings (Aṅguttara-Nikāya)**, Vol. I (Ones, Twos, Threes), p. 74.

kālena kālaṃ samayena samayaṃ upādāya katamāni cattāri atthisukhaṃ atthisukhaṃ anaṇasukhaṃ anavajjasukhaṃ"[102]

The Exalted One once said this to the housefather Anāthapiṇḍika:

> Housefather, there are these four kinds of bliss to be won by the householder who enjoys the pleasures of sense from time to time and when occasion offers. What four? The bliss of ownership, the bliss of wealth, the bliss of debtlessness, and the bliss of blamelessness.[103]

Four Kinds of House-life Happiness (*gihisukha*)[104]

1. The bliss of ownership (*atthisukha*): Happiness is the pride that comes from the wealth that comes with the righteousness of one's own effort.

2. The bliss of wealth (*atthisukha*): Happiness is the pride that comes from spending money for oneself livelihood and others.

3. The bliss of debtlessness (*anaṇasukha*): Happiness is caused by non-debt is no outstanding debt.

4. The bliss of blamelessness (*anavajjasukha*): Happiness is caused by good behavior without penalty. Righteous conducts which cannot be blamed, neither bodily nor verbally and mentally.

In Buddhism, there are two types of happiness, "That of home, and that of home-leaving"[105] (*gihī* and *pabbajja*),[106]

While another dyad of sukha is physical-mental.

(1) Physical happiness (*kāyika-sukha*) is the happiness that results from physical components can perform the normal function, not malfunction, such as seeing beautiful pictures; hearing pleasurable

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[102] A.II.69.

[103] A.II.69; Woodward, F.L. (tr.), **The Book of the Gradual Sayings (Anguttara-Nikāya)**, Vol. II (The Book of the Fours), (London: PTS, 1982), p. 77.

[104] "*Kāma-bhogī-sukha*" is also called - Phra Brahmagunabhorn (P. A. Payutto), **Dictionary of Buddhism**, 16th ed. (Thai Version), (Bkk: S. R. Printing Mass Product Ltd., 2008), p. 147.

[105] F. L. Woodward (tr.), **The Book of the Gradual Sayings (Anguttara-Nikāya)**, Vol. I (Ones, Twos, Threes), (London: PTS, 1979), p. 74.

[106] A.I.80.

sounds; smelling odorous; tasting delicious taste; and touching tangible soft. They are called the contact from sensual pleasures (*kāmaguṇa*), (ear, nose, nose, tongue, body),

(2) Mental happiness (*cetasika-sukha*) means that the mind is delighted, cheerful, not bothered by the power of defilement in mental doors: greed, hatred and delusion, the cause of sorrow and grief. The mental happiness is the state of mind that is usually bright, cheerful, not dull with the mind-objects that comes to mind.

Phramaha Hansa Dhammahaso claims the life with good health according to Buddhism must associate with both kinds of happiness.[107] Venerable Mahāsi Sayādaw has stated there are two kinds of happiness, sensual and non-sensual. When six sense-objects supply satisfaction or pleasure, it is called *vedayita sukha*, happiness derived from the senses. While peace and happiness not derived from sensual pleasures constitute *avedayita sukha*.[108]

He further views on the true happiness:

> True bliss is *santi sukha*, bliss of peace and serenity. You may think that sensual pleasures give you happiness, but that is not true happiness. No real peace and happiness is possible unless a man is freedom the selfish desire and egoism caused by the threefold craving. It is the way out of this craving the attainment of eternal peace that is taught by the Buddhist doctrine of *nibbāna* as the supreme destiny awaiting all humanity.[109]

In regard to the relationship between *sukha* and *kusala*, the implication of the term *kusala* is defined in the Atthasālinī as the 4 following meanings: (1) *ārogya* (of good health), (2) *anavajja* (faultless), (3) *cheka* (clever), and (4) *sukhavipāka* (productive of happy results).

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[107] Phramaha Hansa Dhammahaso, **Buddhism and Modern Sciences**, (Thai Version), (Bangkok: Sukhumvit Press Ltd., 2555 B.E.), p. 328.

[108] Venerable Mahāsi Sayādaw, **On the Nature of Nibbāna**, Tr. By U Htin Fatt, Ed. by Bhikkhu Pesala, (Rangoon: Buddha Sāsanānuggaha Organisation, 2013), pp. x, 23.

[109] Op.cit.

Kusalasaddo tāva ārogyānavajjacchekasukhavipākesu dissati.[110] First of all, the word "*kusala*" (moral) means "of good health," "faultless," "skillful," "productive of happy sentient results," etc.[111]

Anuruddhacāra Thera views the difference between the two states "*sukha* expresses physical happiness differentiated from *somanassa,* mental pleasure."[112] Merit, that a man has thus heaped up with believing heart, careless of insupportable ills of the body, brings to pass hundreds of results which are a mine of happiness; therefore one must do works of merit with believing heart.[113] With the mind locating in the middle of every emotional experience Ven. Khenpo Karjung mentions "Happiness achieves from the root of mind (*citta*) but accordingly it rooted from the teachings of the Buddha. So mind can be very flexible and achieve the happiness"[114]

The crucial point, as the Exalted One pointed out, is that there is other happiness that truly exists among each *sukha* Dyad, which is the higher happiness that is more profound. They are called "The Thirteen Superior *sukhas*", in which consisting of: - (1) Home-leaving (*pabbajjā-sukha*), (2) Renunciation (*nekkhamma-sukha*), (3) Not clinging to rebirth (*nirupadhi-sukha*), (4) Attends freedom from the *āsavas* (*ānāsava-sukha*), (5) Non-carnal (*nirāmisa-sukha*), (6) Ariyan (*ariya-sukha*), (7) Mental (*cetasika-sukha*), (8) Without zest (*nippīti-sukha*), (9) Indifference (*epekkhā-sukha*), (10) Musing concentration (*samādhi-sukha*), (11) Object of meditation which does not arouses zest (*nippītikārammaṇañ-sukha*), (12) Object that causes indifference (*upekkhārammaṇañ-sukha*), and (13) Formless for object of meditation (*arūpārammaṇañ-sukha*). These thirteen superior *sukhas* should be considerably selected to experience.

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[110] DhsA.38.

[111] Buddhaghosa, **The Expositor (Atthasalini)**, Vol. I. 2 Vols. Set, tr. Maung Tin, (London: The Oxford University Press, 1921), p. 48.

[112] Anuruddhacāra Thera, **A Manual of Abhidhamma (Abhidhammatthasaṅgaha)**, tr. by Narada Maha Thera, (Singapore: Buddhist Meditation Center, 1989), p.153.

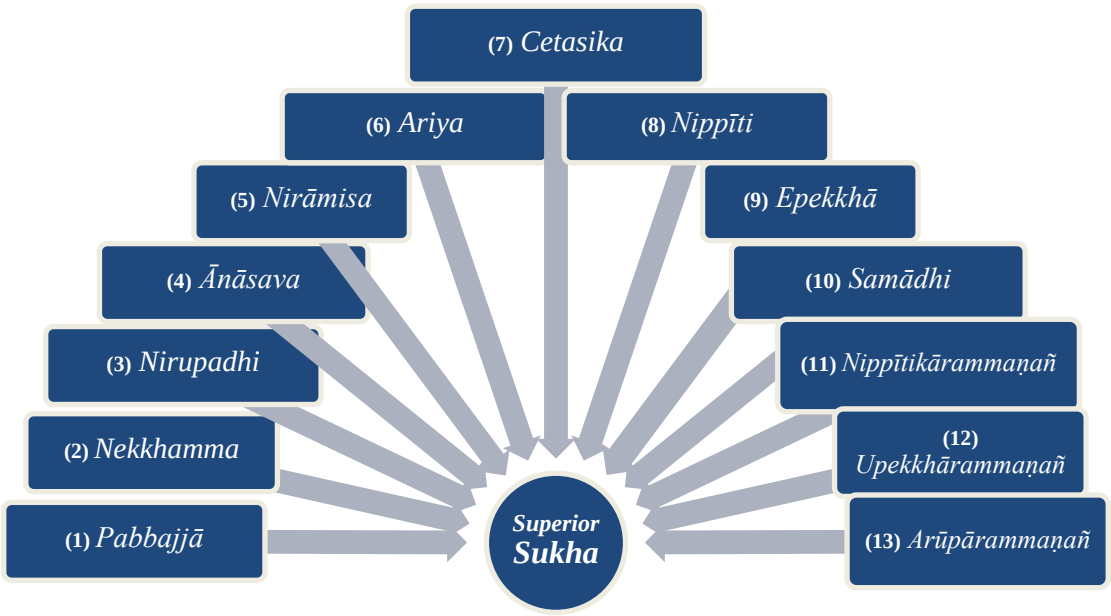
[113] Mvu.40; Wilhelm Geiger (tr.), **The Mahāvaṃsa The Great Chronicle of Ceylon**, (PTS: London, 1912), p. 190.

[114] Interview with Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan, March 25, 2019.

Practitioners should familiarize themselves in order to choose wisely to access to these states of more subtle *sukhas*.

For an even more open perspective, such pre-eminence of *sukha* may be replaced by the following figure named The Thirteen Superior *sukhas*, as follows.

Figure 4.4: The Thirteen Superior *Sukhas*



Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

In conclusion, there are two main types of happiness. They are: - 1) Happiness in the Concentration, and 2) The Thirteen Dyads of Happiness in the Sukha-vagga. 1) Happiness in the Concentration implies various states of mind that appeared in the context of the concentration consisting of five types, namely: - Gladdening (*pāmojja*), Happiness (*pīti*), Tranquility (*passaddhi*), Bliss (*sukha*), and Concentration (*samādhi*). They represent the five different kinds of state of happiness. This type of happiness is the one that will be discussed, analyzed, and integrated into the presenting Model again later. Having happy habit *(sukha-sīla)* as a fundamental level of happiness, the said particular

happiness can be achieved gradually. They reflect good qualities of mind when it is properly trained by the four absorptions of the right concentration (*sammā-samādhi*). And eventually it will lead to the *Nibbāna*, the summit of human's liberation or the greatest happiness of mankind.

While the Thirteen Dyads of Happiness in the Sukha-vagga implies the thirteen different pairs of happiness (*sukha*), consisting of Pleasure of home (*gihi-sukha*), and pleasure of home-leaving (*pabbajjā-sukha*), for instance. Among such those, there are the higher happiness that are more profound and pre-eminance. They are called "The Thirteen Superior *sukhas*" consisting of: - (1) Home-leaving (*pabbajjā-sukha*), (2) Renunciation (*nekkhamma-sukha*), (3) Not clinging to rebirth (*nirupadhi-sukha*), (4) Attends freedom from the *āsavas* (*ānāsava-sukha*), (5) Non-carnal (*nirāmisa-sukha*), (6) Ariyan (*ariya-sukha*), (7) Mental (*cetasika-sukha*), (8) Without zest (*nippīti-sukha*), (9) Indifference (*epekkhā-sukha*), (10) Musing concentration (*samādhi-sukha*), (11) Object of meditation which does not arouses zest (*nippītikārammaṇañ-sukha*), (12) Object that causes indifference (*upekkhārammaṇañ-sukha*), and (13) Formless for object of meditation (*arūpārammaṇañ-sukha*). Therefore the practitioners should wisely choose to access these said *sukhas*.

However, due to the said two types of happiness as discussed in detail above, the first type of happiness is specific to "Happiness in meditation"; while the second type of happiness is characterized by a wide area covering from the mundane (*lokīya*) to the supra mundane level (*lokuttara*). It causes restrictions on analysis and integration with the model that the research team will present later on. For this reason the research team will use only type 1 happiness to be analyzed, discussed and integrated in order to create the model for access to happiness later.

4.1.2 Practices of Happiness Access according to Buddhist Principle

Due to the fact that happiness does not exist only in one type, therefore, the approach to access to the happiness can be more than one way either from worldly happiness to the supreme one. Jayasaro Ācāriya views:

> . . . the more clearly we see the nature of things, the less we suffer, and the happier we become. Indeed, the Buddha referred to Nibbāna, the goal of Buddhist practice, as 'the supreme happiness'. Worldly happiness is fleeting and unreliable. The happiness of a cultivated mind is a lasting refuge.[115]

Practices to access to happiness have a close relationship with wellbeing. Gay Watson "Beyond happiness lies a way to wellbeing"[116] The practices of happiness access according to Buddhist principle are classified by the two key ways, namely: - 1) Happiness Access through Mental Development (*dhammasamādhi*), 2) Happiness Access through Wisdom Development, and 3) Access to Happiness above Happiness (*sukhapaṭisaṃvedanāya saphalappadhāna*).

a. Happiness Access through Mental Development (*Dhammasamādhi*)

Dhammasamādhi denotes Dhamma that strengthen the firm commitment in the Dhamma in order for the confidence in practice correctly without doubts. When the concentration of the Dhamma occurs, the commitment of the mind arises. In spite of T.W. Rhys Davids and William Stede views it is almost identical with *samatha*[117], Phra Brahmagunabhorn (P. A. Payutto) views it includes *vipassanā* either:

> These five features are for practitioners who are moving forward to achieve the fruition of the absorptions (*samatha*) or insight (*vipassanā*), depending on circumstances. Therefore, it can be used as a measure of performance during the process, and as important qualities of the mind that everyone should always train.[118]

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[115] Ajahn Jayasaro, **Without and Within: Questions and Answers on the Teachings of Theravada Buddhism**, (Bkk: Buddhadasa Indapanno Archives, 2013), p. 50.

[116] Gay Watson, **Beyond Happiness: Deepening the Dialogue between Buddhism, Psychotherapy and the Mind Sciences**, (London: Karnac Books Ltd., 2008), p. 5.

[117] T.W. Rhys Davids and William Stede (eds.), **The Pāli Text Society's Pāli-English Dictionary**, Part IV (Cit-No), 8 Vols. Set, p. 144.

[118] Phra Brahmagunabhorn (P. A. Payutto), **Dictionary of Buddhism**, 16th ed. (Thai Version), pp. 164-165.

Once the Blessed One said to Rāsiya the headman in the Gāmaṇisaṃyutta: *"Atthi gāmaṇi dhammasamādhi tatra ce tvaṃ cittasamādhiṃ paṭilabheyyāsi evaṃ tvaṃ imaṃ kaṅkhādhammaṃ pajaheyyāsi"*[119] "There is, headman, concentration of the Dhamma. If you were to obtain concentration of mind in that, you might abandon this state of perplexity.[120] The concentration of the Dhamma signifies the five kinds of virtues that make one to be firmness in the Dhamma. They are Gladdening (*pāmojja*), Happiness (*pīti*), Tranquility (*passaddhi*), Bliss (*sukha*), and Concentration (*samādhi*): "*Atha vā 'pāmojjaṃ jāyati, pamuditassa pīti jāyatī' ti evaṃ-vuttā-pāmojja-pīti-passaddhi-sukha-samādhi-saṅkhātā pañca dhammā dhamma-samādhi nāma*"[121] in which they have been thoroughly discussed in the earlier topic of this Chapter. Among the abovementioned virtues, gladdening for instance, they give rise to each other as dependent things. The Buddha thus said:

> When one is gladdened (*pāmojja*), rapture is born (*pīti*). When the mind is elated by rapture the body becomes tranquil (*passaddhi*). One tranquil in body experiences happiness (*sukha*). The mind of one who is happy becomes concentrated (*samādhi*).[122]

"*Atha vā pamujjaṃ jāyati, pamuditassa pīti jāyati ti. . .*" '*pamujjaṃ jāyati*' the five Dhammas is when the gladdening occurs, happiness then arises. It is the name of concentration of the Dhamma.[123]

1. Five Factors of *Dhammasamādhi*

1) Gladdening (*pāmojja*)

2) Happiness (*pīti*)

3) Tranquility (*passaddhi*)

4) Bliss (*sukha*)

5) Concentration (*samādhi*).

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[119] S.IV.350.

[120] Bhikkhu Bodhi (tr.), **The Connected Discourses of the Buddha A New Translation of the Saṃyutta Nikāya**, Vol. II. 2 Vols. Set, p. 1367.

[121] SA.III.110.

[122] S.IV.357; Bhikkhu Bodhi (tr.), **The Connected Discourses of the Buddha A New Translation of the Saṃyutta Nikāya**, Vol. II. 2 Vols. Set, p. 1367.

[123] SA.III.110.

Phra Rajapariyatkavi (Somjin Wanjan) has explained all of the above happiness is factors that bring happiness to life in full dimensions. Both the physical and mental dimensions:

> Indeed, concentration itself is not a direct healer or maintainer of the system of the body, but of the factors of concentration [*dhammasamādhi*]. It is because these various concentrating factors cause non-anxiety. Therefore, when the processes of mind work with the nervous system, it works together smoothly. The blood flow and wind elements are working normal.[124]

What makes this phenomenon even more interesting is that aside from the mind being able to transmit good quality mental signals to the body's nervous system; it also communicates to other body systems as well. For example, circulatory system, various elements (*dhātu*) system, etc. Ven. Khenpo Phuntsho Gyaltshen adds the idea:

> Mind is over matter, basically if you know this table is real then table can become sort of either of happiness or suffering for you. But if you know the table is empty, it does not exist in reality. So the knower is our mind who knows the ultimate empty of the table. So knowing in such way, whatever that happens to the table, it does not hurt the mind. Whatever the mind thinks, you can create that way.[125]

It may be said that the mind is simultaneously the thinker and the knower. If the mind doesn't have good quality, the unwise knower will be created. On the contrary if the mind is of good quality, then the wise knower will be created instead. And this is the reason why the mind should be trained to develop its quality, competency, and mental health. Geeta Manaktala views such nature of mind:

> The mind is as important as a psychological process of human beings. It perceive and aware of the surrounding things. Though one

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[124] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

[125] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

cannot be able to understand all of that, the main thing is one has to know who one is.[126]

In the Sāratthappakāsinī, Bhadantacariya Buddhaghosa has illuminated that "*Ayaṃ kho gāmaṇi dhammasamādhi, tatra ce tvaṃ cittasamādhiṃ paṭilabheyyāsīti ettha dhammasamādhīti dasakusalakammapathakammā*"[127] which is literally translated as *dhammasamādhi* refers to the ten wholesome courses of action (*kusala-kammapatha*). The ten wholesome courses of action constitute the ten Dhamma factors, as follows:

2. *Dhammasamādhi* as *Kusala-kammapatha*[128]

1) *Pāṇātipātā veramaṇī* (avoidance of taking life),

2) *Adinnādānā veramaṇī* (avoidance of taking what is not given),

3) *Kāmesumicchācārā veramaṇī* (avoidance of sexual misconduct),

4) *Musāvādā veramaṇī* (avoidance of lying speech),

5) *Pisuṇāya vācāya veramaṇī* (avoidance of slander),

6) *Pharusāya vācāya veramaṇī* (avoidance of rude speech),

7) *Samphappalāpā veramaṇī* (avoidance of idle chatter),

8) *Anabhijjhā* (non-covetousness),

9) *Abyāpāda* (non-illwill),

10) *Sammādiṭṭhi* (right view).[129]

Not only the ***Kusala-kammapatha*** which has just listed above, but *dhammasamādhi* as per the Commentator's view can also refer to the four sublime states of mind (*brahma-vihāra*). Bhadantacariya Buddhaghosa further illuminated "*cattāro brahmavihārā cāti ayaṃ*

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[126] Interview with Prof. Dr. Geeta Manaktala, Panjab University, Chandigarh, India, Mar 25, 2019.

[127] SA.III.110.

[128] SA.III.110.

[129] D.III.269, 290; Maurice Walshe (tr.), **Thus Have I Heard: The Long Discourses of the Buddha (Dīgha Nikāya)**, pp. 508-509.

dhammasamādhi nāma"[130] *which can be rendered as* the four sublime states of mind is the name of *dhammasamādhi*. They comprise of four Dhamma factors, namely:

3. *Dhammasamādhi* as *Brahma-vihāra*[131]

1) *Mettā* (loving-kindness),

2) *Karuṇā* (compassion),

3) *Muditā* (sympathetic joy),

4) *Upekkhā* (equanimity).[132]

Among them, loving-kindness is invariably practiced by Buddhists whilst compassion is one of the most widely accepted ways in the West. The key to happiness is a practical way of experimenting with the idea of finding happiness through compassion.[133] This is affirmed by Geeta Manaktala:

> Happiness is only when you have the contentment; when you have compassion for the other person; when you have love for the other people; and when you feel happy for doing things for them. That is happiness.[134]

It is as true as the said word. Happiness is a mental state that occurs with the four mental qualities mentioned above, which are loving-kindness, compassion, sympathetic joy and equanimity. The four factors make *Brahma-vihāra*, the dwelling place of Brahmin. And a person who practices such those will spread love to others and will help all human beings with compassion together with sympathetic joy. Such person will also have self-train the equanimity.

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[130] SA.III.110.

[131] SA.III.110.

[132] A.III.226; Hare, E.M. (tr.), **The Book of the Gradual Sayings (Anguttara-Nikāya)**, Vol. III (The Books of the Fives and Sixes), (London: PTS, 1973), p. 165.

[133] Lorne Ladner, **The Lost Art of Compassion: Discovering the Practice of Happiness in the Meeting of Buddhism and Psychology**, (n.p. Harper Collins), p. 188.

[134] Interview with Prof. Dr. Geeta Manaktala, Panjab University, Chandigarh, India, Mar 25, 2019.

The result from practicing the concentration of the Dhamma that one can expect for is that one's mind can be trained properly and developed gradually into a mental state called "concentration of mind" (*citta-samadhi*) is a qualified state of mind with good quality, efficiency and effectively. A state of mind full of capability to work as best as it is. The Commentator explained the concentration of mind as the four paths (*maggas*) and the insight meditation or one-pointedness of consciousness (*citta-ekaggatā*).[135]

4. *Dhammasamādhi* as Concentrative Meditations (*samādhi-bhāvanā*)

Since the Concentration of the Dhamma (*Dhammasamādhi*) defines the development of human life in terms of training and refining the mind to its better quality, the *dhammasamādhi* thus implies as Concentrative Meditations (*samādhi-bhāvanā*). The Buddha suggests in the Saṅgīti Sutta of the Dīga Nikāya the dwelling of happiness here and now (*diṭṭhadhamma-sukha-vihāra*) can be empirically accessed through concentrative meditations (*samādhi-bhāvanā*):

> *Catasso samādhi-bhāvanā. Atth' āvuso samādhi-bhāvanā bhāvitā Bahulī-katā diṭṭhadhamma-sukha-vihārāya saṃvattati. Atth' āvuso samādhi-bhāvanā bhāvitā bahulī-katā ñāṇa-dassana-paṭilābhāya saṃvat-tati. Atth' āvuso samādhi-bhāvanā bhāvitā bahulī-katā sati-sampajaññāya saṃvattati. Atth' āvuso samādhi-bhāvanā bhāvitā bahulī-katā āsavānaṃ khayāya saṃvattati.*[136]
>
> Four concentrative meditations (*samādhi-bhāvanā*). This meditation, when developed and expanded, leads to 1) happiness here and now (*diṭṭhadhamma-sukha*), 2) gaining knowledge-and-vision (*ñāṇa-dassana-paṭilābha*), 3) mindfulness and clear awareness (*sati-sampajañña*), and 4) the destruction of the corruptions (*āsavānam khaya*).[137]

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[135] "*cittass' ekaggatā.*" - Dhs. 9; "*cittassa ekaggatā.*" - Vbh.257.

[136] D.III.222.

[137] D.III.222; Maurice Walshe (tr.), **Thus Have I Heard: The Long Discourses of the Buddha (Dīgha Nikāya)**, p. 488.

By a wise consideration on what are the four *jhānas* and properly practicing on them, one can systematically attain preliminary to the happiness here and now and even further more subtle progressive Dhamma conditions: "How does this practice lead to happiness here and now? Here, a monk practices the four *jhānas*."[138] The Buddha philosophy of *samādhi* allows us to see the world from the third eyes not physical eyes.[139] As consequences, not only the happiness here and now that can be accessed, but *ñāṇa-dassana-paṭilābha* can also be achieved. Moreover, one who professionally understands them will perform all of one's actions mindfully with clear awareness at all times. And at the summit of things, one will be able to destroy all of the corruptions gradually.

In conclusion, the concentration of the Dhamma signifies the five kinds of virtues that make one to be firmness in the Dhamma. They are Gladdening (*pāmojja*), Happiness (*pīti*), Tranquility (*passaddhi*), Bliss (*sukha*), and Concentration (*samādhi*). It gives three different implications, firstly to (1) the ten wholesome courses of action, secondly to (2) the four sublime states of mind. These implications give rise to the concentration of mind as the four paths (*maggas*) and the one-pointedness of consciousness (*citta-ekaggatā*). Lastly, to (3) concentrative meditations where it leads to the total destruction of the corruptions (*āsavānam khaya*) is Nibbāna.

b. Happiness Access through Wisdom Development

When talking about the wisdom dimension of mankind, Buddhism emphasizes great importance to wisdom. If mundane wisdom refers to the intelligence in life, ability in analyzing life plans, potentiality in learning life, including capability in solving all kinds of life problems through the years; Then ultimate wisdom must refers to the intelligence in understanding the world, understanding life and understanding nature as

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[138] *"Katam' āvuso samādhi-bhāvanā bhāvitā bahulī-katā diṭṭhadhamma-sukha-vihārāya saṃvattati? Idh' āvuso bhikkhu vivicc' eva kāmehi vivicca akusalehi dhammehi paṭhamajjhānaṃ. . . dutiyajjhānaṃ. . . tatiyajjhānaṃ. . . catutthajjhānaṃ upasampajja viharati."* - D.III.222.

[139] Interview with Prof. Dr. Geeta Manaktala, Panjab University, Chandigarh, India, Mar 25, 2019.

they truly are. That is to attain the state of enlightenment or Nibbāna. Phillip D. Stanley suggests that Buddhists should not limit themselves only to the development of the mind:

> From the Buddhist point of view, one not limiting oneself, if one does meditation with studying Buddhist teachings to develop the wisdom (*paññā*) and pondering consider ethics. His or her meditation will have much more profound deeper benefits. It's not only calming one's body and mind but it taking benefit on one's wisdom and making it more skillful.[140]

Thus happiness may also be reached through human wisdom. Todd Lewis and Gary De Angelis claimed:

> *sukha* is more associated with mental development than with any form of material acquisition. The most important tool to achieve this mental stage is through training of the mind through meditation to reach the stage of *pañña* (wisdom or insight) the ability to understand reality clearly, everything according to its own nature. Therefore, *pañña* is instrumental in being relieved from pain. With no pain, it will be *sukha* or wellness of the mind, despite the inevitable decline of the mortal body. An individual who perfects his or her *pañña* may experience enlightenment.[141]

David Burton mentions that human's wisdom can remove the ignorance (*avijjā*), cravings (*tanhā*), and attachments (*upādāna*) of human nature:

> If one reflects seriously on the terrible suffering that attachments can cause, it is hard to dismiss outright the attraction of a life of nonattachment with its promise of peace and freedom from emotional vicissitudes. A plausible way forward might be to condone attachments to certain things (for example, one's family) and in certain respects (for example, in moderation). In effect, this is what

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[140] Interview with Prof. Dr. Phillip D. Stanley, Naropa University, Colorado, United States, Jan 13, 2019.

[141] Todd Lewis and Gary DeAngelis (eds), **Teaching Buddhism: New Insights on Understanding and Presenting the Traditions**, (New York: Oxford University Press, 2017), p. 351.

> Buddhist lay ethics seeks to achieve, as opposed to the more strenuous pursuit of nonattachment by monastics. Furthermore, even if one rejects the ultimate Buddhist goal of complete non-attachment, the Buddhist meditation and ethical techniques may prevent one from forming excessive or inappropriate attachments. These techniques may also be useful when dealing with the painful consequences of one's attachments.[142]

Wisdom is essential to develop a high level of happiness; whereas, a high level of consumption and resource use may not lead to an increase in happiness.[143] Ven. Khenpo Karjung agreed "What we need is just to have the beneficial mind first. And then what we need to follow to the mind is the contentment that relates to the closeness of happiness."[144] So that one who is with wisdom will always have wise consideration on one's choices of life based on the contentment and happy mind. Ven. Khenpo Phuntsho Gyaltshen gives an interestingly Vajrayānic philosophical view:

> According to Vajrayānic philosophy, apart from the physical body and morality or ethics, mind is the crucial element here; even wisdom is the part of the mind. So when one obtains the true nature or actualize the true quality of the mind that is actually wisdom. Buddhist Vajrayānic conceptualizes wisdom and *citta* as one.[145]

From the above statement, wisdom exposed itself in the sense that can be understood as a mental-derivation thing for rational analysis of all things in order to gain knowledge and to understand ourselves, including our surroundings. Buddhism examines mind and its process of working in terms of practice for mental training by doing meditation both

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[142] David Burton, **Buddhism: a Contemporary Philosophical Investigation**, (New York: Routledge, 2017), p. 29.

[143] Dr. Sauwalak Kittiprapas, "Buddhist Sustainable Development through Inner Happiness", **Research Report**, (BKK: International Research Associates for Happy Societies (IRAH) and Faculty of Economics, Rangsit University, Thailand, 2016), pp. iii-iv.

[144] Interview with Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan, March 25, 2019.

[145] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

in tranquil and insight meditation. The aim is to enhance the capability of mind in order to overcome or control the defilements.[146] Healthy elements focus on physical well-being with environmental protection; mental well-being deals with concentration; intellectual well-being deals with wisdom augmentation; social well-being deals with good society and social works. The importance of well-beings focuses on good health. The Buddhist teachings relating to well-beings focus on the four foundations of mindfulness, the four developments.[147] Sanu Mahatthanadull et al. suggest: There are four ways of development of holistic happiness (s*ukha-bhāva*) for balanced way of life according to Buddhist Psychology, namely: - (1) Physical Well-being Promotion, (2) Moral Well-being Promotion, (3) Mental Well-being Promotion, and (4) Intellectual Well-being Promotion.[148] Although some researches have slightly different compositions[149]

> As the majority of men cling to security and contentment, there is a "half obscurity" about their condition, as within the hidden and remote recesses of their happiness, there dwells an anxious despair.

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[146] Phrakrupalad Marut Varamangalo, Asst.Prof.Dr., "An Analytical Study of Buddhist Psychology in Tipitaka", **A Research Report, Department of Pariyattidhamma and Cariya Studies**, (Faculty of Education: Mahachulalongkornrajavidyalaya University, 2010), p. Abstract A.

[147] Phrakru Sirirattananuwat, Assoc.Prof.Dr., "Concept and the Process of Well-being Promotion according to Buddhist Psychology", (Thai Version), **A Research Report Funded by National Research Council of Thailand (NRCT) Fiscal Year 2016**, (Buddhist Research Institute: Mahachulalongkornrajavidyalaya University, 2018), pp. 47-49.

[148] Asst. Prof. Dr. Sanu Mahatthanadull and Dr. Sarita Mahatthanadull, "Holistic Well-beings Promotion for Balanced Way of Life according to Buddhist Psychology", **Research Report**, (Buddhist Research Institute: Mahachulalongkornrajavidyalaya University, 2559 B.E.), pp. 137-138.

[149] Phra Dhammamoli (Thongyu Ñāṇavisuddho) presented in his Ph.D. Dissertation as "The elements of holistic well-beings can be classified into four areas, namely: (1) physical, (2) mental, (3) moral is social and environment, and (4) wisdom." - see Phra Dhammamoli (Thongyu Ñāṇavisuddho), "An Analytical Study of Lifestyle, Health Behaviors And Holistic Health Care of the Buddhist Monks as Appeared in the Tipitaka", (Thai Version), **A Ph.D. Dissertation**, (Graduate School: Mahachulalongkornrajavidyalaya University, 2551 B.E.), p. abstract A.

> The Buddha says, though they may be manifold and sweet (*kāmācitrā madhurā*), they cause suffering (*dukkha*), unpleasantness, and turbulence. With some, it becomes an entanglement from which one cannot escape and thus it moves around in a vicious circle. The most important point is that the discord of the pleasure-lover is a facet of Buddhist *dukkha*, though Buddhist *dukkha* has wider ramifications.[150]

From a Buddhist perspective peaceful coexistence between human kind and the natural world provides intrinsic metaphors for a holistic peace. [151]

Due to the fact that happiness is a condition that occurs in the mind which affects the growth of the body of the psycho-physiological organisms called human beings. Therefore in practicing of happiness access, both side of body and mind must be trained. Sanu Mahatthanadull views "In Buddhism, there is a way of setting up the equilibrium of the human body systems by using the items of the practice suitable for those life-supporting factors according to the principle of the Middle Path.**"**[152]

In conclusion, happiness access through wisdom development based on the principles of holistic development of human beings that consists of four dimensions, namely physical development, moral development, mental development, and intellectual development. It can be clearly seen that the dimension of human's wisdom is an integrated vital part in augmenting human intelligence to the maximum extent, which is to intellectually understand the nature and the universal states of nature as they truly are.

Therefore, the access to happiness through the human wisdom is the perpetual happiness that human beings worthy deserve. It is

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[150] Padmasiri de Silva, **The Psychology of Emotions and Humour in Buddhism**, (Cham: Palgrave Macmillan, 2018), pp.33, 51-52.

[151] Padmasiri de Silva, **The Psychology of Buddhism in Conflict Studies**, (Cham: Palgrave Macmillan, 2017), p. 22.

[152] Sanu Mahatthanadull, "Buddhist Integrated Approach for the Equilibrium of Human Body Systems", (Thai Version), **Ph.D. Dissertation in Buddhist Studies**, (Graduate School: Mahachulalongkornrajavidyalaya University, 2549 B.E.), pp. Abstract A-B, 127.

happiness at a level that is extremely discreet. In other words, it is the happiness that comes from living according to the Buddhist middle path.

c. Access to Happiness above Happiness

(*Sukhapaṭisaṃvedanāya saphalappadhāna*)

This is the principle of determined striving that can ultimately result in eradicating of sufferings and access to happiness. The practitioner must behave correctly to both suffering (*dukkha*) and happiness (*sukha*). In which it is in accordance with Buddhist right practices that shows the right striving always result in the accessible of the higher and highest kind of happiness. The Devadaha Sutta states:

> *Kathañ ca, bhikkhave, saphalo upakkamo hoti saphalaṃ padhānaṃ? Idha, bhikkhave, bhikkhu na heva anaddhabhūtaṃ attānaṃ dukkhena addhabhāveti, dhammikañ ca sukhaṃ na pariccajati. tasmiñ ca sukhe anadhimucchite hoti. So evaṃ pajānāti: Imassa kho me dukkhanidānassa saṅkhāraṃ padahato saṅkhārappadhānā virāgo hoti. . .*[153]
>
> Here, bhikkhus, a bhikkhu is not overwhelmed by suffering and does not overwhelm himself with suffering; and he does not give up the pleasure that accords with Dhamma, yet he is not infatuated with that pleasure. He knows thus: When I strive with determination, this particular source of suffering fades away in me because of that determined striving.[154]

From the above Sutta, there are 4 steps to deal with *dukkha* and *sukha*:

1. Being not overwhelmed by suffering and one does not overwhelm himself with suffering;

2. One does not give up the pleasure (*sukha*) that accords with Dhamma,

3. One is not infatuated with that pleasure.

4. One strives with determination for the fading away of the source of suffering.

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[153] *Devadahasuttam* - M.II.223.

[154] M.II.223; Bhikkhu Ñāṇamoli, Bhikku Bodhi (trs.), **The Middle Length Discourses of the Buddha A Translation of the Majjhima Nikāya,** (Oxford: PTS, 2001), p. 833.

It is merely impossible for a man who searches for happiness who does not know what suffering is. This is because happiness and suffering are dualism.

Even though the *dukkha-sukha* dichotomy has been systematically stated in the Buddhist scriptures both primary and secondary sources, nevertheless the profundity of this dualism can seriously support to one's perversions[155] (*vipallāsa*)[156] among one's perception, thought and view as stated in the Book of the Gradual Sayings:

> To hold that in the impermanent there is permanence is a perversion of perception, thought and view. To hold that in the not-ill there is ill is a perversion of perception, thought and view. To hold that in the not-self there is self is a perversion of perception thought and view. To hold that in the foul there is the fair is a perversion of perception, thought and view. These are the four perversions of perception, thought and view.[157]

For this reason one assuredly cannot overcome this dualism if one still has the dualistic system of thinking.

Thus how one should behave to happiness is crucial important. In order accessing to the happiness, firstly one needs to know the suffering completely. When one knows it, one can make a plan and find ways to eradicate that suffering; so one does not overwhelm himself with suffering. Secondly, one must not give up searching for the righteous happiness and finally the happiness can be sustainably accessed. Thirdly, once the happiness is accessible, one must not be infatuated with that happiness. This is because the worldly happiness is so easy to be obsesses by the one who have possessed. Lastly, striving with determination to eradicate the cause of suffering can effectively overcome it. That is to say one should not practice just to experience the worldly happiness but diligently practice in order to access to the highest happiness in the ultimate level, happiness attends freedom from the *āsavas* (*ānāsava-sukha*) or happiness belongs to the ariyan (*ariya-sukha*), for instance. That is when one truly understands things as they truly are with one's

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[155] Woodward, F.L. (tr.), **The Book of the Gradual Sayings (Anguttara-Nikāya)**, Vol. II (The Book of the Fours), (London: PTS, 2008), p. 60.

[156] A.II.52.

[157] Ibid., pp. 61-62.

right view[158] (*sammā-diṭṭhi*)[159] with an ability to avoid all wrong ways of practice[160] and to choose right mental disposition (*sammā-paṭipaṭṭi*),[161] he or she can be able to gradually access to the happiness above happiness.

In conclusion, "Access to Happiness above Happiness" implies the four steps to deal with the *dukkha-sukha* dichotomy of dualism. The Buddhist practice based on this way is just to conform to the Devadaha sutta. It is a guideline for managing both suffering (*dukkha*) and happiness (*sukha*) just in order to deal with them using the four wise steps: 1) The ability to live with existing sufferings, 2) The pursuit of righteous happiness, 3) detachment to the happiness acquired, and finally 4) Total elimination of suffering. A practitioner who follows these steps can ultimately eradicate all sufferings and access to perpetual happiness. That is one should avoid all wrong ways of practice but always try to practice in accordance with the Buddhist right mental disposition (*sammā-paṭipaṭṭi*) in which it also requires one's right view (*sammā-diṭṭhi*) either. And this shows that the right striving always result in the accessible of the happiness above happiness, that is, higher and highest kind of happiness, until one gets to the Nibbāna eventually.

4.1.3 Origin and Development of GNH

In 2008, the Constitution of Bhutan, enacted on 18 July 2008, the Bhutanese Government instituted the Gross National Happiness as the goal of the government of Bhutan to develop the country. As appeared in the Article 9: Principles of State Policy, item 2: "The State shall strive to promote those conditions that will enable the pursuit of Gross National Happiness."[162]

Gross National Happiness is grounded as the basic concept that happiness is a universal aspiration and should be located at the core of

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[158] Right view according to the Noble Eightfold Path directly refers to the knowledge on Sufferings.

". . . Knowledge, bhikkhus, about ill, knowledge about the coming to be of ill, knowledge about the cessation of ill, knowledge about the Way that leads to the cessation of ill. This is what is called right view." - T.W. and C.A.F. Rhys Davids (trs.), **Dialogues of the Buddha Translated from the Pāli of the Dīgha Nikāya**, Part II, p. 343.

[159] D.II.312.

[160] *Vippaṭipatti* means wrong way, error, sin" - Vism.511.

[161] A.I.69; Nett.27; Miln.97.

[162] Royal Government of Bhutan, **The Constitution of the Kingdom of Bhutan**, (Bhutan: National Council, 2008), p. 18.

development. The accumulation of wealth is not the desired end of development, but it is a means that must be balanced by the multiple other dimensions that is beneficial to happiness. “The concept of Gross National Happiness was articulated by His Majesty to indicate that development has many more dimensions than those associated with Gross Domestic Product, and that development should be understood as a process that seeks to maximize happiness rather than economic growth. The concept places the individual at the center of all development efforts and it recognizes that the individual has material, spiritual and emotional needs.”[163]

The Gross National Happiness (GNH) is not only a national multidimensional development model for Bhutan but also a defining component of the image of the Bhutanese state itself, portraying an autonomous and coherent entity leading the pursuit of national happiness in partnership with Bhutanese society.[164] GNH policy implementation is a complex process of conflictive, cooperative and isolating practices characterized by fractured expressions of power. Governance actors have different degrees of influence in different policy fields, geographic regions or constellations of governance actors. These fractured expressions of power are not shaped in any meaningful way by GNH governance instruments. Nor are they rooted in a common understanding of GNH itself.[165]

“The concept of Gross National Happiness …rejects the notion that there is a direct and unambiguous relationship between wealth and happiness. If such a relationship existed, it would follow that those in the richest countries should be happiest in the world. We know that this is not

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[163] Planning Commission, **Bhutan 2020: A Vision for Peace, Prosperity and Happiness, Part II.** (Thimphu: Planning Commission, Royal Government of Bhutan, 1999), pp. 10-11.

[164] Kent Schroeder, **Politics of Gross National Happiness: Governance and Development in Bhutan**, (Cham, Switzerland: Springer Nature, 2018), p. 21.

[165] Kent Schroeder, “The Politics of Gross National Happiness Image and Practice in the Implementation of Bhutan’s Multidimensional Development Strategy”, **A Doctor of Philosophy Thesis (Political Science and International Development)**, (Graduate School: The University of Guelph, Ontario, Canada, 2014), pp. 295-309.

the case. This marginal increase (of the population that consider themselves to be happy) has also been accompanied by growth of many social problems as well as such phenomena as stress-related diseases as well as suicides-surely antithesis of happiness"[166]

Benedict Anderson views as 'imagined community' of a happy Bhutanese nation. ". . . is imagined because the members of even the smallest nation will never know most of their fellow-members, meet them, or even hear of them, yet in the minds of each lives the image of their communion"[167]

Lately in 2019, the 2019 report[168] specifically focuses on happiness and the community and how happiness has evolved over the past 12 years. The World Happiness Report 2019 was released by the Sustainable Development Solutions Network for the United Nations on 20 March. As one of the Bhutanese attending the high-powered event in the grand dining room of the UN Headquarters, one could not help but wonder why Bhutan was ranked 95th.[169] The above points out that the implementation of this concept must continue to be developed. Nowadays, Bhutan is still known to the world community as Gross National Happiness as the country that founded this concept; it is the first country and has been continuously developed to the present day.

However, in this study, it is not intended to primarily analyze operational issues under the theories, but rather to the advent and development of the present day.

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[166] Planning Commission, **Bhutan 2020: A Vision of Peace, Prosperity and Happiness**, (Thimphu: Government Publications, 1999), p. 46. in Akiko Ueda, **Culture and Modernization: From the Perspectives of Young People in Bhutan**, (Thimphu: The Centre for Bhutan Studies, 2003), p. 113.

[167] Benedict Anderson, **Imagined Communities: Reflections on the Origin and Spread of Nationalism**, (New York: Verso, 1983), pp. 6-7.

[168] John F. Helliwell; Richard Layard and Jeffrey D. Sachs (eds.), **World Happiness Report 2019**, (New York: Sustainable Development Solutions Network, 2019), p. 25.

[169] Daily Bhutan, "Known As The Kingdom Of Happiness, Why Is Bhutan Ranked 95th In The World Happiness Report 2019?", **Daily Bhutan**. Vol. 13 (Oct, 2019): 1.

4.1.4 Practices of GNH

A Middle Way path between materialist heedlessness and traditional immobility is a Buddhist choice; a choice between modern growth and traditional stagnation can never be a choice at the extreme but always in the middle of them. Now the issue is: the metaphysical and epistemological justifications of the relevance and utility of GNH has to be grounded in such Buddhist doctrines and philosophy[170] which is actually created for a happy living.[171]

GNH's focus on multiple dimensions rooted in a Buddhist ethic that values integration, balance and compromise across these dimensions is often referred to as the "Middle Path".[172] Central to the focus on happiness within GNH is its definition of happiness as a balance between the material and non-material dimensions of life. While GNH rejects the idea of an "unambiguous relationships between wealth and happiness"[173] It does not reject economic growth itself, recognizing its important interconnection to achieving non-material, mental, emotional and spiritual dimensions of development.[174] Happiness is realized through the complementary interaction and harmonization between "inner skills of happiness" and "outer circumstances".[175] Ven. Dr. Khenpo Phuntsho Gyaltshen adds:

> From the Buddhist teaching of GNH, one cannot judge one's qualities from outside but within. For example if a person thinks that a car is a source of happiness. It will just disappear when the car

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[170] Johannes Dragsbaek Schmidt (ed.), **Development Challenges in Bhutan: Perspectives on Inequality and Gross National Happiness**, (Cham, Switzerland: Springer International Publishing, 2017), p. 86.

[171] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

[172] S. B. F. Hargens, "Integral development: Taking the 'Middle Path' towards Gross National Happiness", **Journal of Bhutan Studies**. Vol. 6, (2002): 24-87.

[173] Planning Commission, **Bhutan 2020: A Vision for Peace, Prosperity and Happiness, Part II.**, p. 11.

[174] GNH Commission, **Tenth Five Year Plan 2008-2013, Vol. 1: Main Document**, (Thimphu: GNH Commission, 2009), p. 18.

[175] GNH Commission/UNDP, **Bhutan National Human Development Report 2011**, (Thimphu: GNH Commission, 2011), p. 16.

> break down or has accident. The car objectively becomes source of suffering.[176]

The inner skills of happiness has implemented as the main strategy in GNH. He further asks a question: How could a car become a source of GNH?[177] The answer is naturally within the human inner wisdom. Ven. Khenpo Karjung also adds about the skillfully contentment-based mind:

> What we need for the countries are truly economics, health, education, everything. Only mind with the background of contentment can potentially bring us to the closeness of happiness. However, if mind without contentment, people become more materialistic and cannot stop greedy consume.[178]

Our approach to development has sought to both draw upon and conserve this rich fund of social and cultural philosophy and to achieve a balance between the spiritual and material aspects of life, between economic development (*peljor gongphel*) and happiness and peace (*gakid*).[179] But happiness is proactive. It requires your active understanding that it cannot exist without being shared. Happiness is not a state of being that one can achieve privately or personally without others sharing it. When you are contributing to others happiness, you know that you are improving your own chances of happiness and to that extent you become socially responsible and valuable as a member of the community and society.[180]

Our approach to development has been shaped by the beliefs and values of the faith we have held for more than 1,000 years. Firmly

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[176] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

[177] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

[178] Interview with Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan, March 25, 2019.

[179] Planning Commission, **Bhutan 2020: A Vision for Peace, Prosperity and Happiness, Part I, (**Thimphu: Planning Commission, Royal Government of Bhutan, 1999), p. 19.

[180] R. McDonald, **Taking Happiness Seriously: Eleven Dialogues on Gross National Happiness**, (Thimphu: Centre for Bhutan Studies., 2010), p.4.

rooted in our rich tradition of Mahayana Buddhism, the approach stresses not material rewards, but individual development, sanctity of life, compassion for others, respect for nature, social harmony, and the importance of compromise.[181]

Bhutan's form of Tibetan Buddhism distinguishes between two forms of consciousness - *dukha* and *sukha* - that have different implications for happiness.[182] *Dukha* is a state of consciousness that pursues 'happiness' in the form of immediate pleasure for the individual. It is an unstable and temporary form of pleasure based on self-centeredness. It is a form of pleasure that relies on external, impermanent material stimulations for its satisfaction. *Dukha* is referred to as an "unskillful" form of consciousness.[183] *Sukha* represents a more "skillful" form of consciousness that moves beyond the need for superficial pleasure fulfillment through external and material stimulation. It incorporates a more stable and foundational form of happiness that emphasizes balanced emotional, mental and spiritual aspects of fulfillment, regardless of changes in material conditions.[184] The Buddha outlined the Noble Eightfold Path as the means to end suffering and achieve genuine happiness and enlightenment. The fifth path, "Right Livelihood", involves balancing the relationships between three

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[181] Planning Commission, **Bhutan 2020: A Vision for Peace, Prosperity and Happiness, Part I,** p. 19.

[182] R. McDonald, "The future of Gross National Happiness", in K. Ura and D. Penjore (eds.), **Gross National Happiness: Practice and Measurement, The Proceedings of the Fourth International Conference on Gross National Happiness**, (Thimphu: Centre for Bhutan Studies, 2009): 613-631; M. Ricard, "The Dalai Lama: Happiness from within", **International Journal of Wellbeing**. Vol. 1 No. 2 (2011): 274-290.

[183] R. McDonald, "The future of Gross National Happiness", in K. Ura and D. Penjore (eds.), **Gross National Happiness: Practice and Measurement, The Proceedings of the Fourth International Conference on Gross National Happiness**: 616.

[184] P. Ekman, R. Davidson, M. Ricard and B.A. Wallace, "Buddhist and Psychological Perspectives on Emotions and Wellbeing", **Current Directions in Psychological Science**. Vol. 14 No. 2 (2005): 59-63; M. Ricard, "The Dalai Lama: Happiness from within", **International Journal of Wellbeing**. Vol. 1 No. 2 (2011): 274-290.

interconnected components: human, social and environment.[185] Is there any skillful means under the concept of GNH? Follow is the answer from Ven. Khenpo Karjung, a Vajrayāna scholar monk:

> Skillful comes from the root of mind putting together in the right livelihood (*sammā-ājīva*). But if you go beyond the wrong doing with such skillful, then it becomes wrong livelihood (*micchā-ājīva*). Skillful is the middle path to the right way and right things. Skill means start the righteous work. We do not want to disrupt the world. We need our education to get skillful with the right thing.[186]

The practices of Gross National Happiness are officially constructed under the four pillars[187] are described in the following way, namely: - 1) Sustainable and Equitable Social and Economic Development, 2) Environmental Conservation, 3) Cultural Preservation and Promotion, and 4) Good Governance.

a. Sustainable and Equitable Social and Economic Development

The Bhutan Poverty Analysis Report (2004) revealed 31.7% of the populations live under the poverty line. Of these 97% are in the rural areas.[188] The monthly income poverty line per capita income was calculated as Nu.740.[189]

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[185] C. Rinzin, W. Vermeulen and P. Glasbergen, "Public perceptions of Bhutan's Approach to Sustainable Development in Practice", **Sustainable Development**. Vol. 15 (2007): 52-68.

[186] Interview with Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan, March 25, 2019.

[187] RGoB, Bhutan National Human Development Report, (Thimphu: Royal Government of Bhutan, 2005); Planning Commission, **Bhutan 2020: A Vision for Peace, Prosperity and Happiness, Part I-II.** (Thimphu: Planning Commission, Royal Government of Bhutan, 1999).

[188] United Nations Development Programme (UNDP) and Bhutan, **Assessment of Development Results: Evaluation of UNDP's Contribution**, (New York: One United Nations Plaza, 2007), p. 17.

[189] Maggie Black and Peter Stalker, **Common Country Assessment for Bhutan**, (Thimphu: United Nations in Bhutan, 2006), p. 14.

Frey and Stutzer discussed the unsatisfactory link between materialism and happiness in developed countries such as the United States and Japan:

> Over time, however, happiness in western countries and Japan does not systematically increase, despite considerable growth in real per-capita income. This can be attributed to the rise in aspiration levels going with increases in income. Between countries, and at per-capita income levels much below the United States, higher average income goes with higher average happiness but the improvements in reported subjective well-being seem to be rather small[190]

In search of an ideal beyond human conflict and violence, and economic imperialism, Bhutan provides the lasting images of integrating many lamps but one light-the best model of 'Cultural Environmentalism'. Bhutan typifies a fine blend of the environment and human peace in harmony.[191]

According to the statement of the fourth king "We do not wish to be swept away by the tide of materialism and consumerism. We are determined to preserve our rich spiritual and cultural values and traditions. At the same time, we must achieve a high level of economic growth with equality in order to improve the quality of life of our people".[192]

b. Environmental Conservation

The idea of sustainability is based on traditional beliefs that rivers, streams, rocks, mountains and soil are the domain of spirits and that indigenous practices like traditional farming, institutions that manage community grazing land, forests and local knowledge are seen as vital to

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[190] Bruno S Frey and Alois Stutzer, "What can Economists learn from Happiness Research?", **Journal of Economic Literature**, Vol. 40 No. 2 (2002): 402-435.

[191] Padmasiri de Silva, **The Psychology of Buddhism in Conflict Studies**, p. 22.

[192] B.C. Upreti, "Gross National Happiness and Foreign Policy in Bhutan: Interlinkages and Imperatives", **Proceeding Report on Rethinking Development: Local Pathways to Global Wellbeing Conference**, June 20-24, Antigonish, Nova Scotia, Canada (2005): 6.

preserving nature. They are seen as one of the many intangible aspects of development. This concept is reflected strongly in Bhutan's environmental conservation policies.[193]

Article 5 of the Bhutanese constitution commits the government and each Bhutanese citizen to be a responsible steward of the environment for the benefit of both current and future generations.

c. Cultural Preservation and Promotion

The main aim of culture and tradition is seen as enforcing Bhutanese identity survival in the huge face of modernization by articulating Bhutan as being different from the west and the western model of development.[194]

"The significance of economic growth for development is more than cultural factors. Because there are indicators measuring 'economic growth' it is dominant while 'cultural growth' cannot be measured"[195]

"There is a common understanding amongst Bhutanese people that culture is very important, serves as Bhutan's identity and has a symbolic role that separates Bhutan from the rest of the world"[196]

Successfully preserving and promoting Bhutanese culture must recognize culture as dynamic. It requires a balance between fostering cultural uniqueness on the one hand and cautiously drawing upon the benefits of other cultural influences, including globalization, on the other hand.[197]

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[193] Chhewang Rinzin, Walter J. V Vermeulen, and Pieter Glasbergen, "Public Perceptions of Bhutan's Approach to Sustainable Development in Practice", **Sustainable Development**, (2006): 60.

[194] Akiko Ueda, **Culture and Modernisation: From the Perspectives of Young People in Bhutan**, (Thimphu: The Centre for Bhutan Studies, 2003), p. 138.

[195] Ronald Inglehart, **Culture Shift in Advanced Industrial Society**, (New Jersey: Princeton University Press, 1990), p. 15.

[196] Chhewang Rinzin, Walter J. V Vermeulen, and Pieter Glasbergen, "Public Perceptions of Bhutan's Approach to Sustainable Development in Practice", **Sustainable Development**. (2006): 60.

[197] Planning Commission, **Bhutan 2020: A Vision for Peace, Prosperity and Happiness, Part II**, pp. 34-35; Planning Commission Secretariat, **Bhutan National Human Development Report 2000**, (Thimphu: Planning Commission Secretariat, Royal Government of Bhutan, 2000), p. 50.

d. Good Governance

As a part of human rights protection, Bhutan is one of the few countries in the world to meet its 20:20 compact of 20% of public investment in health and education.[198]

The concept of GNH has evolved conceptually. In the early 2000s, GNH was expanded from the original four pillars to nine domains in order to give it greater conceptual form.[199] It is known as the Gross National Happiness Index (GNHI) that re-conceptualized the four pillars of GNH into nine domains. These include (1) psychological wellbeing, (2) health, (3) time use, (4) education, (5) cultural diversity and resilience, (6) good governance, (7) community vitality, (8) ecological diversity and resilience, and (9) living standard. The GNHI measures the nine domains of GNH by using a set of 33 clustered and weighted indicators that can be further disaggregated into 124 variables.[200] However, the four pillars are often still viewed as the overarching framework of Gross National Happiness.[201]

The four pillars of GNH and their nine domains act as a strategic framework that is rooted in Buddhist values. It guides the achievement of happiness as the end of development.

In addition, the education is also focused by GNH. The Educating for Gross National Happiness (EGNH) initiative is viewed as one of the main frameworks for the promotion of Gross National Happiness (GNH) in Bhutan. Therefore, in recent years, the nationwide implementation of the EGNH initiative has become the focal point of education reform in Bhutan. As an operational GNH framework, a primary focus of the EGNH initiative is to provide those conditions that lead to quality and equity in education. This chapter evaluates the EGNH

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[198] United Nations Development Programme (UNDP) and Bhutan, **Common Country Assessment for Bhutan**, (Thimphu: UN House, 2006), p. 17.

[199] K. Ura, S. Alkire and T. Zangmo, "Case Study: Bhutan. Gross National Happiness and the GNH Index", in J. Helliwell, R. Layard and J. Sachs (eds.), **World Happiness Report**, (New York: Columbia University, 2012): 109.

[200] Ibid., :109-146.

[201] GNH Commission, **Tenth Five Year Plan 2008-2013 Vol. 1: Main Document**, p. 18.

framework to assess how the EGNH initiative can provide the necessary conditions for well-being and happiness to enable the pursuit of GNH in Bhutan.[202]

Table 4.3: Practice of Happiness Access according to Buddhist Principle and GNH

Buddhist Principle	GNH
1. Mental Development (*Dhammasamādhi*) 2. Wisdom Development 3. Happiness above Happiness (*Sukhapaṭisaṃvedanāya saphalappadhāna*)	1. Sustainable and Equitable Social and Economic Development 2. Environmental Conservation 3. Cultural Preservation and Promotion 4. Good Governance

Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

In conclusion, the Concept of Happiness Access according to Buddhist Principles and the Concept of Gross National Happiness (GNH) are as follows:

Definitions and Types of Happiness according to Buddhist Principle: Firstly, Definitions of Happiness according to Buddhist Principle started by studying the vital term "happiness" is an English word is literally translated from multiple Pāli terms, such as, *iṭṭha*, *nibbuti*, *pasīdana*, *pāmujja*, *pāmojja*, *pīti*, *bhagga*, *vaḍḍhi*, *vitti*, *sampatti*, *sampadā*, *sampasādana*, *sātatā*, *siva*, *sukha*, *sugati*, *suhatā*, *seyya*, *sokhya*, *somanassa*. Especially the term "*sukha*" refers to the idea of happiness of the world. When it accompanies with physical body, it is called bodily happiness. And when it accompanies with mind, it is called mental happiness. Happiness (*sukha*) has suffering (*dukkha*) as the

[202] Pema Tshomo, "Conditions of Happiness: Bhutan's Educating for Gross National Happiness Initiative and the Capability Approach", in **Education in Bhutan: Culture, Schooling, and Gross National Happiness**, Eds. by Matthew J. -Schuelka and T. W. Maxwell, (Singapore: Springer Science+Business Media Singapore, 2016): 139.

opposite state. While "*pīti*" implies happy-mindedness in the context of the fivefold absorption, is a pleasure of happiness [in the first and second absorption] or *pītisukha*. Nevertheless in this research, the happiness that is mentioned here will be a specific context of happiness in the dimension of the mental and wisdom development, for example, *pāmojja*, *pīti*, *sukha*, etc.

Secondly, Types of Happiness according to Buddhist Principle refers to two main types of happiness. They are: - 1) Happiness in the Concentration, and 2) The Thirteen Dyads of Happiness in the Sukha-vagga. 1) Happiness in the Concentration implies various states of mind that appeared in the context of the concentration consisting of three groups, namely: - (1) Happiness (*pīti*), (2) Bliss (*sukha*), and (3) Gladdening (*pāmojja*) and Tranquility (*passaddhi*). They represent the four kinds of state of happiness, namely: - *pāmojja*, *pīti*, *passaddhi*, and *sukha*. When they all arise together inside one's mind, then the concentration will arise as an effect. Having happy habit *(sukha-sīla)* as a fundamental level of happiness, the said particular happiness can be achieved gradually. They reflect good qualities of mind when it is properly trained by the four absorptions of the right concentration (*sammā-samādhi*). And eventually it will lead to the *Nibbāna*, the summit of human's liberation or the greatest happiness of mankind.

While the Thirteen Dyads of Happiness in the Sukha-vagga implies the thirteen different pairs of happiness (*sukha*), consisting of Pleasure of home (*gihi-sukha*), and pleasure of home-leaving (*pabbajjā-sukha*), for instance. Among such those, there are the higher happiness that are more profound and pre-eminance. They are called "The Thirteen Superior *sukhas*" consisting of: - (1) Home-leaving (*pabbajjā-sukha*), (2) Renunciation (*nekkhamma-sukha*), (3) Not clinging to rebirth (*nirupadhi-sukha*), (4) Attends freedom from the *āsavas* (*ānāsava-sukha*), (5) Non-carnal (*nirāmisa-sukha*), (6) Ariyan (*ariya-sukha*), (7) Mental (*cetasika-sukha*), (8) Without zest (*nippīti-sukha*), (9) Indifference (*epekkhā-sukha*), (10) Musing concentration (*samādhi-sukha*), (11) Object of meditation which does not arouses zest (*nippītikārammaṇañ-sukha*), (12) Object that causes indifference (*upekkhārammaṇañ-sukha*), and (13)

Formless for object of meditation (*arūpārammaṇañ-sukha*). Therefore the practitioners should wisely choose to access these said *sukhas*.

Practices of Happiness Access according to Buddhist Principle: First, the concentration of the Dhamma signifies the five kinds of virtues that make one to be firmness in the Dhamma. They are (1) Gladdening (*pāmojja*), Happiness (*pīti*), Tranquility (*passaddhi*), Bliss (*sukha*), and (5) Concentration (*samādhi*). It gives three different implications, firstly to (1) the ten wholesome courses of action, secondly to (2) the four sublime states of mind. These implications give rise to the concentration of mind as the four paths (*maggas*) and the one-pointedness of consciousness (*citta-ekaggatā*). Lastly, to (3) concentrative meditations where it leads to the total destruction of the corruptions (*āsavānam khaya*) is Nibbāna.

Second, happiness access through wisdom development based on the principles of holistic development of human beings that consists of four dimensions, namely physical development, moral development, mental development, and intellectual development. It can be clearly seen that the dimension of human's wisdom is an integrated vital part in augmenting human intelligence to the maximum extent, which is to intellectually understand the nature and the universal states of nature as they truly are. Therefore, the access to happiness through the human's wisdom is the perpetual happiness that human beings worthy deserve. It is happiness at a level that is extremely discreet. In other words, it is the happiness that comes from living according to the Buddhist middle path.

Third, "Access to Happiness above Happiness" implies the four steps to deal with the *dukkha-sukha* dichotomy of dualism. The Buddhist practice based on this way is just to conform to the Devadaha sutta. It is a guideline for managing both suffering (*dukkha*) and happiness (*sukha*) just in order to deal with them using the four wise steps: 1) The ability to live with existing sufferings, 2) The pursuit of righteous happiness, 3) detachment to the happiness acquired, and finally 4) Total elimination of suffering. A practitioner who follows these steps can ultimately eradicate all sufferings and access to perpetual happiness. That is one should avoid all wrong ways of practice but always try to practice in accordance with

the Buddhist right mental disposition (*sammā-paṭipaṭṭi*) in which it also requires one's right view (*sammā-diṭṭhi*) either. And this shows that the right striving always result in the accessible of the happiness above happiness, that is, higher and highest kind of happiness, until one gets to the Nibbāna eventually.

Origin and development of GNH: Gross National Happiness (GNH) was articulated by His Majesty to indicate that development has many more dimensions than those associated with Gross Domestic Product. It is grounded as the basic concept that happiness is a universal aspiration and should be located at the core of development. In 2008, the Constitution of Bhutan instituted the GNH as the goal of the government of Bhutan to develop the country. Nowadays, Bhutan is still known to the world community as Gross National Happiness as the country that founded this concept. It is the first country and has been continuously developed to the present day.

Practices of GNH: The practices of Gross National Happiness are officially constructed under the four pillars are described in the following way, namely: - 1) Sustainable and Equitable Social and Economic Development, 2) Environmental Conservation, 3) Cultural Preservation and Promotion, and 4) Good Governance. The teachings on the middle path and contentment are also focused as well.

4.2 Theory of Biofeedback

In this topic, the researchers will discuss the theory of Biofeedback in the following step-by-step subtopics: - 1) Historical Perspective of Biofeedback, 2) Meaning of Biofeedback, 3) Ends of Biofeedback Process, 4) Ways of Biofeedback Process, and 5) Means of Biofeedback Process. The details are as follows.

4.2.1 Historical Perspective of Biofeedback

The concept of Biofeedback has originated for the first time during the mid-20th century. In 1961, Neal Miller, an experimental psychologist, suggested that autonomic nervous system responses (for instance, heart rate, blood pressure, gastrointestinal activity, regional blood flow) could be under voluntary control. As a result of his

experiments, he showed that such autonomic processes were controllable. This work led to the creation of biofeedback therapy. Miller's work was expanded by other researchers. Thereafter, research performed in the 1970s by UCLA researcher Dr. Barry Sterman established that both cats and monkeys could be trained to control their brain wave patterns. Sterman then used his research techniques on human patients with epilepsy, where he was able to reduce seizures by 60% with the use of biofeedback techniques. Throughout the 1970s, other researchers published reports of their use of biofeedback in the treatment of cardiac arrhythmias, headaches, Raynaud's syndrome, and excess stomach acid, and as a tool for teaching deep relaxation. Since the early work of Miller and Sterman, biofeedback has developed into a frontline behavioral treatment for an even wider range of disorders and symptoms."[203]

In addition, A.H. Black and A. Cott discussed: "The beginning of modern biofeedback is usually identified with the research of five people in the 1960s: Basmajian, Kamiya, Kimmel, Miller and Olds."[204] The differences in their research seem so great for the response systems that they studied were very different, despite their goals varied. Firstly, Basmajian was interested in understanding the neural systems that control striate muscles.[205] Meanwhile, Kamiya was interested in developing voluntary control over complex psychological states.[206] Then Kimmel and Miller were interested in testing certain theories of learning, which postulated that autonomic responses are not amenable to instrumental or

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[203] Paula Anne Ford-Martin, "Biofeedback", **The GALE Encyclopedia of Medicine**, 4th Ed., ed. By Laurie J. Fundukian, (Farmington Hills: Gale Cengage Leanrning, 2011): 633.

[204] A.H. Black and A. Cott, "A Perspective on Biofeedback", **Biofeedback and Behavior**, eds. By Jackson Beatty and Heiner Legewie, (New York: Plenum Press, 1977): 7-8.

[205] J. V. Basmajian, "Control and training of individual motor units", **Science**, Vol. 141 (1963): 440-441; following up the work of V. F. Harrison and O. A. Mortensen, "Identification and voluntary control of single motor activity in the tibialis anterior muscle, **Anatomical Record**, Vol. 144 (1962): 109-116.

[206] J. Kamiya, "Conscious Control of Brain Waves", **Psychology Today**, (1968): 57-60.

operant control.[207] And lastly, Olds thought that the operant conditioning of single unit activity would be a valuable analytic technique for studying the physiology of the brain, and in particular for understanding the neural basis of learning.

4.2.2 Meaning of Biofeedback

In order for understanding the true meaning of Biofeedback, the two dimensions of the meaning are classified here. They are: - 1) Meaning of Biofeedback According to the Dictionaries and Encyclopedias, and 2) General Meaning of Biofeedback.

a. Meaning of Biofeedback According to the Dictionaries and Encyclopedias

The multidimensional meanings of Biofeedback can be currently found among various branches of sciences. For instance, psychology, psychophysiology and applied psychophysiology etc. Whatsoever, the term Biofeedback, as defined by the Dictionary of Science and Technology, refers to the control of the autonomic nervous system by the patient's conscious thoughts as a response to the results of tests or scans.[208] Whereas the Dictionary of Psychology and Allied Sciences coined the implication that "biofeedback" refers to provision of information to a subject regarding one or more of his physiological processes in the effort to enable the subject to gain some element of voluntary control over bodily functions that normally operate outside consciousness. In addition, there is another definition that is closely related to biofeedback, which is "learned autonomic control" means the learned regulation by a person of physiological responses that are under autonomic nervous system control. Experimental psychologist Neal E.

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[207] R. L. Fowler and E. D. Kimmel, "Operant conditioning of the GSR", **Journal of Experimental Psychology**, Vol. 63 (1962): 563-567; H. D. Kimmel, "Instrumental conditioning of autonomically mediated behavior", **Psychological Bulletin**, Vol. 67 (1967): 337-345; N. E. Miller, "Learning of visceral and glandular responses", **Science**, Vol. 163 (1969): 434-445; N. E. Miller and L. V. DiCara, "Instrumental learning of heart-rate changes in curarized rats: Shaping and specificity to discriminative stimulus", **Journal of Comparative and Physiological Psychology**, Vol. 63 (1967): 12-19.

[208] Simon Collin, **Dictionary of Science and Technology**, 2nd ed., (London: A&C Black Publishers Ltd, 2007), p. 72.

Miller, using biofeedback training techniques demonstrated that such visceral responses are subject to learning.[209]

Moreover, as the term defined in the Chambers Dictionary of Science and Technology, it is, on one side, refers to therapeutic procedures:

> Strictly, any feedback about bodily function, but usually refers to therapeutic procedures whereby subjects are given information about physiological functions that are not normally available to conscious experience (e.g. heart rate, blood pressure, etc). The object is sometimes of gaining some conscious control of these functions.[210]

The abovementioned particular type of procedures, on the other side, reflects a kind of technique as remarked in the Oxford Dictionary of Science:

> The technique whereby a subject can learn to control certain body functions, such as heart rate or blood pressure, that are usually unconsciously regulated by the autonomic nervous system. It is facilitated by the use of monitoring devices, such as pulse monitors, electroencephalographs, and electromyographs, and can be useful in treating high blood pressure, migraine, epilepsy, and other disorders.[211]

Biofeedback is a patient-guided treatment that teaches an individual to control muscle tension, pain, body temperature, brain waves, and other bodily functions and processes through relaxation, visualization, and other cognitive control techniques. The name biofeedback refers to the biological signals that are fed back, or returned, to the patient in order for the patient to develop techniques of

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[209] M.S. Bhatia, **Dictionary of Psychology and Allied Sciences**, (New Delhi: New Age International Publishers, 2009), pp. 49, 237.

[210] John Lackie (ed.), **Chambers Dictionary of Science and Technology**, (Edinburgh: Chambers Harrap Publishers Ltd., 2007), p. 121.

[211] John Daintith, Eliabeth Martin, **Oxford Dictionary of Science,** 6th ed. (New York: Oxford University Press, 2010), p. 92.

manipulating them."[212] Biofeedback also involves with biochemical process of internal communication. Hormones are another kind of biochemical messenger. There are two types, steroid and nonsteroid, that are secreted by glands throughout the body that comprise the endocrine and exocrine systems. By means of a biofeedback mechanism, the hypothalamus is alerted to abnormal biochemical levels; in response, it secretes neurohormones to tell the anterior and posterior lobes of the pituitary to increase or decrease the relevant hormones.[213] As it is defined as:

> Using biofeedback it is possible for people to gain a certain amount of control over such functions as heart rate, blood pressure and BRAIN WAVES through a kind of OPERANT CONDITIONING process.[214]

The Concise Corsini Encyclopedia of Psychology and Behavioral Science provided an explanation that Biofeedback is best understood as a closed feedback loop consisting of a person or other animal, a response, a means to detect the response, and a mechanism for displaying the response to the person or animal-the response is thus feedback.[215] And these are the meanings of Biofeedback from various dictionaries and encyclopedias. Now let us turn to the Biofeedback meaning according to the Applied Psychophysiology.

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[212] Paula Anne Ford-Martin, "Biofeedback", **The GALE Encyclopedia of Medicine**, 4th Ed., ed. By Laurie J. Fundukian, (2011): 633.

[213] Kathryn H. Hollen, "The Reproductive System", **Encyclopedia of Human Body Systems,** Vol.1, ed. By Julie McDowell, (California: Greenwood, 2010): 470.

[214] David A. Statt, **The Concise Dictionary of Psychology**, 3rd ed., (New York: Routledge, 1998), p. 16.

[215] William A. Greene, "Biofeedback", in **The Concise Corsini Encyclopedia of Psychology and Behavioral Science**, 3rd ed. Eds. by W. Edward Craighead and Charles B. Nemeroff, (New Jersey: John Wiley & Sons, Inc., 2004): 121-122.

b. General Meaning of Biofeedback

The term "biofeedback", in general sense, may also be recognized as applied psychophysiological feedback,[216] is a shorthand term for external psychophysiological feedback, physiological feedback, and sometimes augmented proprioception. The basic idea is to provide individuals with increased information about what is going on inside their bodies, including their brains. In essence, biofeedback, used in the broad sense of signals, explanations, and patient education, provides missing or deficient information in the intervention context. This information is helpful for the patient or client, the therapist, or the interaction.[217]

Biofeedback is widespread in nature and, in physiology; the term is synonymous of a servosystem, which controls a biological process such as muscular co-ordination and metabolism. A classic example is that of body temperature regulation, which is kept constant independently of the external temperature. Thermoreceptors continuously measure the core and surface temperatures and send this information to the integration centres. The integration centres, via descending pathways, control the state of the effectors, the skin blood flow, the sweat rate and shivering, and keep the body temperature constant in spite of large changes in the outside temperature. Learning a lesson from nature, bioengineering has codified the basic components of a biofeedback: the process, the sensing elements, the actuators and the controller.[218]

The process is the system that we would like to control, while the sensing elements are devices for measuring the output variable. This

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[216] Paula Anne Ford-Martin, "Biofeedback", **The GALE Encyclopedia of Medicine**, 4th Ed., ed. By Laurie J. Fundukian, (2011): 633.

[217] Mark S. Schwartz, Thomas F. Collura, Joe Kamiya, and Nancy M. Schwartz, "The History and Definitions of Biofeedback and Applied Psychophysiology", in **Biofeedback: a Practitioner's Guide**, 4th ed. Eds. By Mark S. Schwartz, Frank Andrasik, (New York: The Guilford Press, 2016): 12, 16.

[218] Antonio Santoro, Elena Mancini, Ahmad Taher Azar, "Biofeedback Systems and Their Application in the Hemodialysis Therapy", in **Modeling and Control of Dialysis Systems Volume 2: Biofeedback Systems and Soft Computing Techniques of Dialysis**, ed. By Ahmad Taher Azar, (New York: Springer, 2013): 1085-1086.

is the variable that is measured and compared to the input, i.e. the output's reference value. The controller consists of a mathematical model that continuously sets the measured output variable against the reference input and modifies the actuators in order to reduce the differences between them.[219]

However, Biofeedback is a specific type of feedback that trains the mind to respond to new signals. The mind already knows how to respond to many signals. For example, the mind directs the body to shiver when it is cold. Other signals are less obvious, such as skin temperature, brain waves, and muscle movements. By learning to read these signals, a person can learn to control a variety of mind and body conditions. The key is to use instruments that make the body's signals available to the mind[220] for the optimal communication between mind and body.

Therefore, the meanings of biofeedback mentioned above can be exhibited in the table as follow:

[219] Op.cit.

[220] Krista West, **Biofeedback**, (New York: Chelsea House Publishiers, 2007), p. 9.

Table 4.4: Table Summarizing the Meanings of Biofeedback **(Source:** Asst.Prof.Dr.Sanu Mahatthanadull et al, 2020.)

Sources	Definitions
1. Dictionary of Science and Technology	The control of the ANS by the patient's conscious thoughts as a response to the results of tests or scans.
2. Dictionary of Psychology and Allied Sciences	Provision of information to a subject regarding one or more of his physiological processes for the subject to gain some voluntary control over bodily functions.
	The learned regulation by a person of physiological responses that are under ANS control.
3. Chambers Dictionary of Science and Technology	Therapeutic procedures whereby subjects are given information about physiological functions that is not normally available to conscious experience.
4. The Oxford Dictionary of Science	The technique that a subject can learn to control certain body functions that are usually unconsciously regulated by the ANS using monitoring devices.
5. The GALE Encyclopedia of Medicine	A patient-guided treatment that teaches an individual to control bodily functions and processes through cognitive control techniques.
	The biological signals that are fed back to the patient to develop techniques of manipulating them.
6. Encyclopedia of Human Body Systems	Biofeedback involves with biochemical process of internal communication having hormones as a biochemical messenger.
7. The Concise Dictionary of Psychology	Information feedback to individuals about their biological functions.
8. The Concise Corsini Encyclopedia of Psychology and Behavioral Science	A closed feedback loop consisting of a person, a response, a means to detect the response, and a mechanism for displaying the response to the person.
9. General Meanings	Alternative names as applied psychophysiological feedback; external psychophysiological feedback; physiological feedback; or augmented proprioception.
	A servo system which controls a biological process.
	A process of controlling the bodily system, using the sensing elements as devices for measuring the output variable.
	A specific type of feedback that trains the mind to respond to learn to control a variety of mind and body conditions. The key is to use instruments that make the body's signals available to the mind.

In conclusion to the meaning of Biofeedback, it refers to a therapeutic procedures or a patient-guided treatment in the Applied Psychophysiology that employs a physiological responses process technique whereby a subject's mind is trained to gain some element of voluntary control over certain bodily functions that are normally unconsciously regulated by the autonomic nervous system (ANS). It is a closed feedback loop mechanism or a servo system which controls a biological process where the hypothalamus is alerted to abnormal biochemical levels. The essence is to use instruments that make the body's signals decodable to the mind. The biological signals that are fed back to the subject in order for the subject to develop techniques of manipulating them.

4.2.3 Ends of Biofeedback Process

Biofeedback is a psychophysical process that alternatively be used to improve health, performance, and the physiological changes. There are at least six ends of Biofeedback process, namely: - (1) to entrain successive changes in performance and ability to self-regulate, (2) to increase awareness of self in relation to the world, (3) to reduce the stress levels for relaxation, (4) to cure the diseases, (5) to improve the levels of physical performance, and (6) to obtain contemplation and wisdom.

Firstly, Biofeedback aims to entrain successive changes in performance and ability to self-regulate. Urszula Klich[221] states that in biofeedback treatment, the aim is to entrain successive changes in performance and ability to self-regulate. For example, HRV Biofeedback Intervention benefits the self-regulation while visualizing the heart rhythm on the computer screen.[222] Interestingly in mindfulness-based

[221] Urszula Klich, "The Integration of Mindfulness-Based Biofeedback and Compassion in the Healthcare Setting", **Biofeedback**, Vol. 43 Issue 3 (Fall 2015): 111-116.

[222] Cynthia J. Tanis, "The Effects of Heart Rhythm Variability Biofeedback with Emotional Regulation on the Athletic Performance of Women Collegiate Volleyball Players", **Doctor of Philosophy Dissertation**, (Graduate School: Capella University, 2008), p. i.

meditation, a main objective is to increase awareness of self in relation to the world. Sebastian Seb Striefel views that when Biofeedback process is integrated with meditation, "an altered state of consciousness" can be achieved as the primary goal.[223] Besides through merged compassion and mindfulness-based biofeedback (MBB) treatment approaches, a collective goal is to provide individuals with more in-depth and varied training in developing skills such as self-awareness and self-regulation. Consistent with traditional mindfulness-based techniques is the notion of increasing awareness and practicing non-judgment and acceptance. One of the aims of HRV Biofeedback Intervention is to improve self-awareness and increase self-control.[224]

In addition to these ends, Biofeedback practice also aims to reduce the levels of stress and increase the levels of relaxation. Biofeedback can be a means to alleviate a stage of stress. The physical body and emotions blend together. Receives biofeedback in an active stress management process, not just the role as a means of reduction of excessive tension, but, more, a successful biofeedback training gives the individual a sense of subjective control. Connections between emotions and physical reactions are made by means of Biofeedback better perceived and are more controllable. The subjective certainty of being able to influence the current situation is not just Basis of every health thought, but also basis for avoidance from feelings of helplessness.[225] Meditation training together with a biofeedback training program could significantly reduce the stress levels of patients with chronic disease[226]

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[223] "Meditation is generally used to achieve one or more of three primary goals a) contemplation and wisdom, b) an altered state of consciousness, and c) relaxation." - Sebastian Seb Striefel, "Ethical Issues in Meditation" in Meditation: Elevating Consciousness, Improving Health. Ed. by Donald Moss, **Biofeedback**. Vol. 32 No. 3 (Fall 2004): 5-7.

[224] Cynthia J. Tanis, "The Effects of Heart Rhythm Variability Biofeedback with Emotional Regulation on the Athletic Performance of Women Collegiate Volleyball Players", **Doctor of Philosophy Dissertation**, p. i.

[225] Ingrid Pirker-Binder, **Biofeedback in Practice: Vol. 1 Children**, (Vienna: Springer Publishing Company, 2006), (German Version), p. 122.

[226] Kanokporn Thongkhum; Manyat Ruchiwit; Chomchuen Somprasert, "The Effect of Meditation Training together with a Biofeedback Training Program on

for a purpose of "relaxation".[227] HRV Biofeedback Intervention helps reducing the effects of physical and mental stress relating to academic and athletic rigors.[228] As viewed by Ven. Khenpo Phuntsho Gyaltshen that "immediate benefit of biofeedback is keeping oneself healthy and happy".[229] As suggested by Phillip D. Stanley "If you just do meditation it will calm you down and provide some physical benefits"[230] Reason for achieving the physical benefit is as explained:

> Where there is no setting emotion, the body also gets disabled. But when the emotion settles down, the body also chooses settle down. So the calmness comes from the settle down of the emotions. That is what the meditation theory also maintains. When the mind gets away from distraction, it is settles down. And when the mind settled down then the body also settles down.[231]

Moreover, biofeedback is more effective than usual therapy in improving performance of activities, for instance, a performance in lower limb activities in people following stroke[232] as enhancing physical and mental states improving academic and athletic performance.[233] It can also

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the Stress Levels of Chronic Disease Patients" (Thai Version), **Nursing Journal**, Vol. 42 No. 1 (Janurary-March 2015): 24-37.

[227] Sebastian Seb Striefel, "Ethical Issues in Meditation" in Meditation: Elevating Consciousness, Improving Health, Ed. by Donald Moss, **Biofeedback**, Vol. 32 No. 3 (Fall 2004): 5-7.

[228] Cynthia J. Tanis, "The Effects of Heart Rhythm Variability Biofeedback with Emotional Regulation on the Athletic Performance of Women Collegiate Volleyball Players", **Doctor of Philosophy Dissertation**, p. i.

[229] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

[230] Interview with Prof. Dr. Phillip D. Stanley, Naropa University, Colorado, United States, Jan 13, 2019.

[231] Interview with Em. Prof. Dr. Pahalawattage Don Premasiri, University of Peradeniya, Sri Lanka, Jan 26, 2019.

[232] Rosalyn Stanton; Louise Ada; Catherine M Dean; and Elisabeth Preston, "Biofeedback improves performance in lower limb activities more than usual therapy in people following stroke: a systematic review", **Journal of Physiotherapy**, Vol. 63 (2017): 11-16.

[233] Cynthia J. Tanis, "The Effects of Heart Rhythm Variability Biofeedback with Emotional Regulation on the Athletic Performance of Women Collegiate Volleyball Players", **Doctor of Philosophy Dissertation**, p. i.

be practiced in many kinds of sport in order to improve the levels of physical performance of athletes. It has been applied to athletic performance, Raynaud's disease, cardiac abnormalities, migraine headache, functional diarrhea, tension headache, temporomandibular disorder, essential hypertension, diabetes mellitus, Attention-Deficit/Hyperactivity Disorder, gait disorders, urinary incontinence, nocturnal enuresis, irritable bowel syndrome, tinnitus, fibromyalgia, and asthma, as well as to other problems with autonomic involvement such as anxiety, eczema, and sexual arousal. The applications continue to expand, and biofeedback is, in fact, the method of choice in treating Raynaud's disease.[234] The ends or goals of Biofeedback practice as described reflect the human beings' ability to develop one's communication between mind and body to its optimal level. It is worth noting here that if the Biofeedback process is practiced as an integrated approach to the Buddhist meditation, the outcome is far beyond than human's expectation that is the highest achievement of liberation by understanding the true nature as they are. And this is a point where Biofeedback process meets its ends as "contemplation and wisdom".[235] The interesting point here is that if the bio-feedback is utilized in conjunction with the practice of Buddhist meditation, it will bring maximum benefits to humankind. Ven. Khenpo Phuntsho Gyaltshen points out:

> The ultimate benefit of biofeedback [when integrated with Buddhist meditation practice] is actually to delivery oneself from this born nature of suffering, attaining to the Nirvana, that is ultimate benefit.[236]

Therefore, those abovementioned 6 ends of the biofeedback process may be shown as follows:

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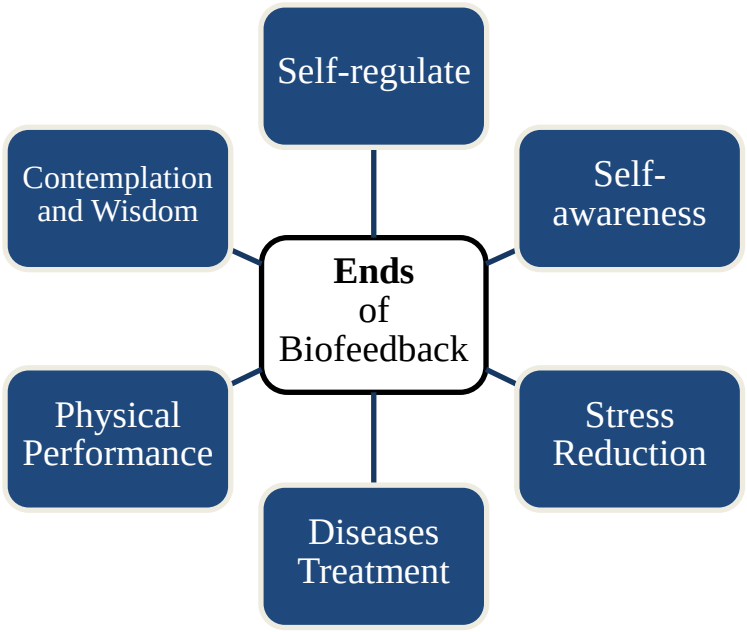
[234] William A. Greene, "Biofeedback", in **The Concise Corsini Encyclopedia of Psychology and Behavioral Science**, 3rd ed., (2004): 121-122.

[235] Sebastian Seb Striefel, "Ethical Issues in Meditation" in Meditation: Elevating Consciousness, Improving Health, ed. by Donald Moss, **Biofeedback**, Vol. 32 No. 3 (Fall 2004): 5-7.

[236] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

Figure 4.5: Various Ends of Biofeedback



Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

4.2.4 Ways of Biofeedback Process

Ways of Biofeedback Process implies a sense of concepts, methods, approaches or ways that have been implemented in the Biofeedback therapeutic procedures. Basic Science at all levels that currently available in the early of 21st century including applied Psychophysiology and Biofeedback are objective and evidence-based fields. They are grounded in an understanding of several related disciplines; neurophysiology, neuroanatomy, cognitive psychology, neuropsychology, cardiovascular physiology, respiratory physiology, public health and others.[237] The concept of this Biofeedback treatment relies on the main principle of multidimensional interdependence of human's body systems, such as nervous system, cardiovascular system and respiratory system. However the ways of biofeedback process may be

[237] The Association for Applied Psychophysiology & Biofeedback (AAPB), "**Biofeedback and Applied Psychophysiology: Rooted in the Past, Empowering the Future**", AAPB 50th Annual Scientific Meeting, March 13-16, 2019, Denver, Colorado, Marriott Tech Center, Preliminary Program (2019), (mimeographed), p. 4.

understood through the two following aspects, namely: - 1) Psycho-Physiological Training Method, and 2) Meditation Relaxation Method.

a. Psycho-Physiological Training Method

Human beings are creatures that have been evolved for long time and consisted of both mental and physical side. The psycho-physiological beings were specially designed to have the most amazing body systems in which they can automatically function for perpetually durable for best existence among surrounding atmospheres. In the human brain there are certain neurons, which control human response to stress and fear. This manifests in terms of certain involuntary responses called autonomic responses. Under stress the body reacts with excessive arousal leading to heightened autonomic responses, namely, increased heart rate, raised blood pressure, increased respiration, excessive sweating, depressed immune defense mechanisms etc. This is essentially a hyper-sympathetic response. Meditation can induce the so-called 'relaxation response'[238] Mehmet Eylem Kirlangic discusses "Many processes of coordination and regulation in human physiology involve phase transitions with nonlinear and non-stationary properties, so does SCP based neurofeedback."[239]

As mentioned earlier that various systems within human's body are interdependence in multidimensional manners. Therefore the nervous system therefore performs important functions closely with other systems especially the cardiovascular system. Through HRV biofeedback, the vagus nerve is thought to be stimulated in such a way that promotes autonomic balance and improved emotion regulation. The findings show

[238] K. K. Deepak, "Brain Mechanisms of Meditation" in Meditation: Elevating Consciousness, Improving Health, ed. by Donald Moss, **Biofeedback**, Vol. 32 No. 3 (Fall 2004): 29-31, 36.

[239] Mehmet Eylem Kirlangic, "EEG-Biofeedback and Epilepsy: Concept, Methodology and Tools for (Neuro) therapy Planning and Objective Evaluation", **Doctor of Engineering Dissertation**, (Faculty of Computer Science and Automation: Ilmenau Technical University, 2004), pp. 104, 107.

that HRV biofeedback to be effective at significantly reducing depressive symptoms.[240] Auditya Purwandini Sutarto et al. described:

> The individual's cardiovascular response or heart rate variability (HRV) biofeedback training works by teaching people to recognize their involuntary HRV and to control patterns of this physiological response. The training is directed to increase HRV amplitude that promotes autonomic nervous system balance. This balance is associated with improved physiological functioning as well as psychological benefits.[241]

The above research thus reflects the effectiveness of HRV biofeedback to the improvement of some cognitive functions in both simulated and real industrial operators. This is a psycho-physiological therapeutic cure through the biofeedback process which deals directly with both sides of human beings, the mind and the body.

Interestingly, there is one of the biofeedback training methods is called Life-Energy Analysis (LEA) in which its goal is to provide awareness about the use of life energy, the individual activation level, the process of activation and deactivation, and to learn self-awareness and self-control of energy us, so as to facilitate work without energy loss and the adequate use of individual resources in the work process. The Life-Energy-Analysis builds on information gained through Life Script Analysis and Work Script Analysis and supplements this subjective information with biofeedback measurement data and additional holistic measurement methods for the analysis of the stress level.[242] Thus it is

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[240] Nasya Brenda Breach, "Heart Rate Variability Biofeedback in the Treatment of Major Depression", **Doctor of Psychology Dissertation (Applied and Professional Psychology)**, (Faculty of the Graduate School: Rutgers, the State University of New Jersey, 2012), pp. ii-iii, 31-33.

[241] Auditya Purwandini Sutarto, Muhammad Nubli Abdul Wahab, Nora Mat Zin Brandmeyer, Arnaud Delorme, "Heart Rate Variability (HRV) biofeedback: A new training approach for operator's performance enhancement", **JIEM**., Vol. 3 No. 1 (2010): 176-198.

[242] Ingrid Pirker-Binder (ed.), **Mindful Prevention of Burnout in Workplace Health Management: Workplace Health Management,**

where the psychological side and physical side of human beings meet together in the psycho-physiological training method.

b. Meditation Relaxation Method

Although Biofeedback process may different in forms and methods of treatment but notice that it uses only meditation-relaxation ways as the core of all treatments. Richard S. Surwit and David Shapiro seem to support the above idea:

> Meditation-relaxation seemed as effective in lowering blood pressure within sessions as either biofeedback technique. Furthermore, decreases in blood pressure from meditation-relaxation were more consistent over sessions than changes achieved through biofeedback. Due to its inherent simplicity, it could be seen to have some advantage over other methods.[243]

One of the hottest topics in health care today involves the effort to identify specific spiritual practices, such as meditation, refine their efficacy, and measure their clinical benefits for psychological disorders, psychophysiological conditions, and medical illness.[244] The practice of meditation has been shown to have discreet psychological and physiological effects.[245] A great deal of biomedical research has focused on Transcendental Meditation in the 1970's, followed later by the Relaxation Response, and more recently by studies of Mindfulness Meditation. Much of this work has repeatedly substantiated the benefits of meditation for physical and mental health and well-being.[246]

Interdisciplinary Concepts, Biofeedback, (Heidelberg: Springer International Publishing AG, 2017): 229.

[243] Richard S. Surwit and David Shapiro, "Biofeedback and Meditation in the Treatment of Borderline Hypertension", **Biofeedback and Behavior**, Eds. By Jackson Beatty and Heiner Legewie, (New York: Plenum Press, 1977): 410-411.

[244] Donald Moss (ed.), "Meditation: Elevating Consciousness, Improving Health", **Biofeedback**, Vol. 32 No. 3 (Fall 2004): 4.

[245] Sat Bir S. Khalsa, "Meditation: Elevating Consciousness, Improving Health" Ed. by Donald Moss, **Biofeedback**, Vol. 32 No. 3 (Fall 2004): 9-10.

[246] Adam Burke, "Meditation Styles: Common Features and Distinguishing Characteristics" in Meditation: Elevating Consciousness, Improving Health Ed. by Donald Moss, **Biofeedback**, Vol. 32 No. 3 (Fall 2004): 13-14.

Meditation was examined with regard to the central nervous system activity pattern involved. Frontal/prefrontal and limbic brain structures play a role in CAM[247], including meditation. Particularly, left-anterior regions of the brain and reward or motivation circuitry constituents are involved, indicating positive affect and emotion-related memory processing.[248] Physiologically, meditation generally involves sensory and motor attenuation, non-analytic attention and non-targeted thinking.[249] The peace and tranquility generated by meditation have been exploited by modern medicine to alleviate misery.[250]

Meditation is a relaxing experience, and has therefore been used primarily for the disorders to which mental stress makes a significant contribution. These disorders include hypertension, coronary artery disease, insomnia, incontinence, headache, chronic pain, especially low back pain, stress-related symptoms in cancer, anxiety disorders and premenstrual syndrome.[251] Physical and mental relaxation, as achieved during meditation, has reproducible physiological effects such as an increase in EEG alpha activity and skin resistance, and a reduction in respiratory rate, oxygen consumption, arterial lactate levels, and

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[247] CAM refers to "Complimentary Alternative Medicine" See Professional Chamber SANATOR the Union of Biotronicists of Josef Zezulka, **Alternative Medicine (CAM) in the World: What is Silenced**, (Prague: Tomas Pfeiffer Publishing House Dimenze 2+2 Praha, 2019), pp. 7-8.

[248] Tobias Esch, Massimo Guarna, Enrica Bianchi and George B. Stefano, "Meditation and Limbic Processes" in Meditation: Elevating Consciousness, Improving Health Ed. by Donald Moss, **Biofeedback**, Vol. 32 No. 3 (Fall 2004): 22-27, 32.

[249] K.K. Deepak, "Neurophysiological mechanisms of induction of meditation: a Hypothetico-deductive Approach", **Indian Journal of Physiology and Pharmacology**, Vol. 46 (2002): 136-158.

[250] Ramesh L. Bijlani, "Demystifying Meditation" in Meditation: Elevating Consciousness, Improving Health Ed. by Donald Moss, **Biofeedback**, Vol. 32 No. 3 (Fall 2004): 16-20.

[251] K.A. Barrows and B.P. Jacobs, "Mind-body Medicine: An Introduction and Review of the Literature", **Medical Clinical of North America**, Vol. 86 (2002): 11-31; J.A. Astin, S.L. Shapiro, D.M. Eisenberg and K.L. Forys, "Mind-body Medicine: State of the Science, Implications for Practice", **Journal of American Board of Family Practice**, Vol. 16 (2003): 131-147.

sympathetic activity.[252] Supriya Rai explains how meditation helps in relaxing:

> Sometimes we feel the pain because we try to hold it. But when we release and let it go in meditation practice, it has a great impact on the pain. Even though the pain still not goes but we have ability to bear with the pain or improve the ability to tolerate.
>
> So the people who have chronic things, repeated Migraine disorders or having some surgeries. The pain is certainly not going anywhere. If they have negative feedback to feel pain, this produces only terrible feeling.[253]

From the said passage, ordinary people who do not have experiences in meditation practice habitually have emotions and perceptions by their innate instincts that respond automatically to stimuli around them. It is called "The instinctively-thinking activities of mind". Which is completely different to the developed states of mind of a meditation practitioner which knowing one's own nature and able to intelligently endure the environment.

One of the striking methods is breathing manipulation. David A. Cramer and Tish Davidson explain: "Biofeedback is a treatment method that uses monitors to reveal physiological information to patients, to teach relaxation and deep breathing methods that may help people with asthma."[254] This is the same method that the Buddha skillfully utilized as the main method of meditation in Buddhism, known as "Mindfulness of

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[252] B.K. Anand, G.S. Chhina and B. Singh, "Some Aspects of Electroencephalographic Studies in Yogis, **Electroencephalography and Clinical Neurophysiology**, Vol. 13 (1961): 452-456; R.K. Wallace and H. Benson, "The Physiology of Meditation", **Scientific American**, Vol. 226 No. 2 (1972): 85-90; R.P. Vempati and S. Telles, "Yoga-based Guided Relaxation Reduces Sympathetic Activity Judged from Baseline Levels", **Psychological Reports**, Vol. 90 (2002): 487-494.

[253] Interview with Dr. Supriya Rai, Director, K. J. Somaiya Centre for Buddhist Studies, India, Jan 17, 2019.

[254] David A. Cramer and Tish Davidson, "Asthma", **The GALE Encyclopedia of Medicine**, 4th Ed., ed. By Laurie J. Fundukian, (2011): 508.

breathing meditation" *(ānāpānasati-bhāvanā*).[255] That is skillfully applied to patients in coping with suffering and pain as Supriya Rai suggests "Contemplating on the breathing and training how we would let it go, let the pain goes by being conscious that pain is there. This may help."[256] The breathing method of meditation is placed right here as in the same way as in Buddhism in which it is called skillful means (*upāya-kosalla*).[257] Peter Harvey adds "Certainly mindfulness of the body not only helps develop the mind of the practitioner. If one cultivates the mind, it helps one physically act and speak in the most skillful way or skillful means (*upāya-kusala*)".[258] That is to say it is wise knowing in utilizing Meditation-relaxation as a means to solve issuing problems and gradually accomplish the state of well-being. Ven. Dr. Khenpo Phuntsho Gyaltshen agreed to this fact by saying "Our body reacts to the vital organs, they reacts to the body. One can learn such interactions when in the meditation practice"[259] Peter Harvey, a Buddhist scholar and a practitioner, who used to be an experimental group in the Biofeedback meditation course. He shared his personal experience:

> The research findings indicated that different people use different part of their brain to do the same thing depending on their characters. But what brain works certainly effect the mind. So for the persons who well-practice concentration meditation (*samādhi-bhāvanā*), it will effect to their brain works.[260]

At the end he give a good conclusion "mind controls physical body and controls some vital sign too but often the mind is not very in

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[255] *Ānāpānasati-bhāvanā* can be appeared in many forms, for instance: - *"Ānāpāna-pabba* in *kāyānupassanā satipaṭṭhāna*". D.II.290-315; M.I.55-63; "10 *Saññā*" - D.III.291; A.V.109; "10 *Anussati*" - A.I.30, 41; Vism.197; *"Soḷasa-vatthuka-ānāpānasati"* - Vin.III.70; M.I.425; M.III.82; S.V.311; A.V.111; Ps.I.162.

[256] Interview with Dr. Supriya Rai, Director, K. J. Somaiya Centre for Buddhist Studies, India, Jan 17, 2019.

[257] D.III.220; Vbh.325.

[258] Interview with Em. Prof. Dr. Peter Harvey, University of Sunderland, United Kingdom, Jan 13, 2019.

[259] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

[260] Interview with Em. Prof. Dr. Peter Harvey, University of Sunderland, United Kingdom, Jan 13, 2019.

controlling of itself."[261] However, in terms of applying the mindfulness into the biofeedback practice, Inna Z. Khazan has pointed out a step-by-step guide to integrating mindfulness into your biofeedback practice can be applied in the following 3 steps;

Step 1: Conduct your typical initial evaluation and biofeedback assessment(s). Let your client know that mindfulness and acceptance are a part of how you conduct biofeedback, give a brief introduction to mindfulness, and address any concerns the client might have about the approach.[262] For instance, in order to examine a sport/exercise-psychological theory, researchers are advised to conduct empirical investigations that integrate laboratory and field settings, together with computer simulations. As Hatfield and Landers[263] indicates, psychophysiological assessment of athletes should be useful primarily in terms of diagnosis and intervention. The figure below shows such claimed:[264] Therefore this step plays a crucial role as the stage of opening the mind widely to comply the method with faith and confidence.

Step 2: Introduce mindfulness and acceptance of the current experience, allowing it to be the way it is, making no changes. This step is necessary in order to help the client develop awareness of thoughts, emotions, and physiological sensations and let go of the struggle with the present experience.[265]

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[261] Interview with Em. Prof. Dr. Peter Harvey, University of Sunderland, United Kingdom, Jan 13, 2019.

[262] Inna Z. Khazan, **The Clinical Handbook of Biofeedback: A Step-by-Step Guide for Training and Practice with Mindfulness**, (West Sussex: John Wiley & Sons, Ltd., 2013), pp. 16-17.

[263] B. D. Hatfield, D. M. Landers, "Psychophysiology-A new direction for sport psychology", **Journal of Sport Psychology**, No. 5 (1983): 243-259.

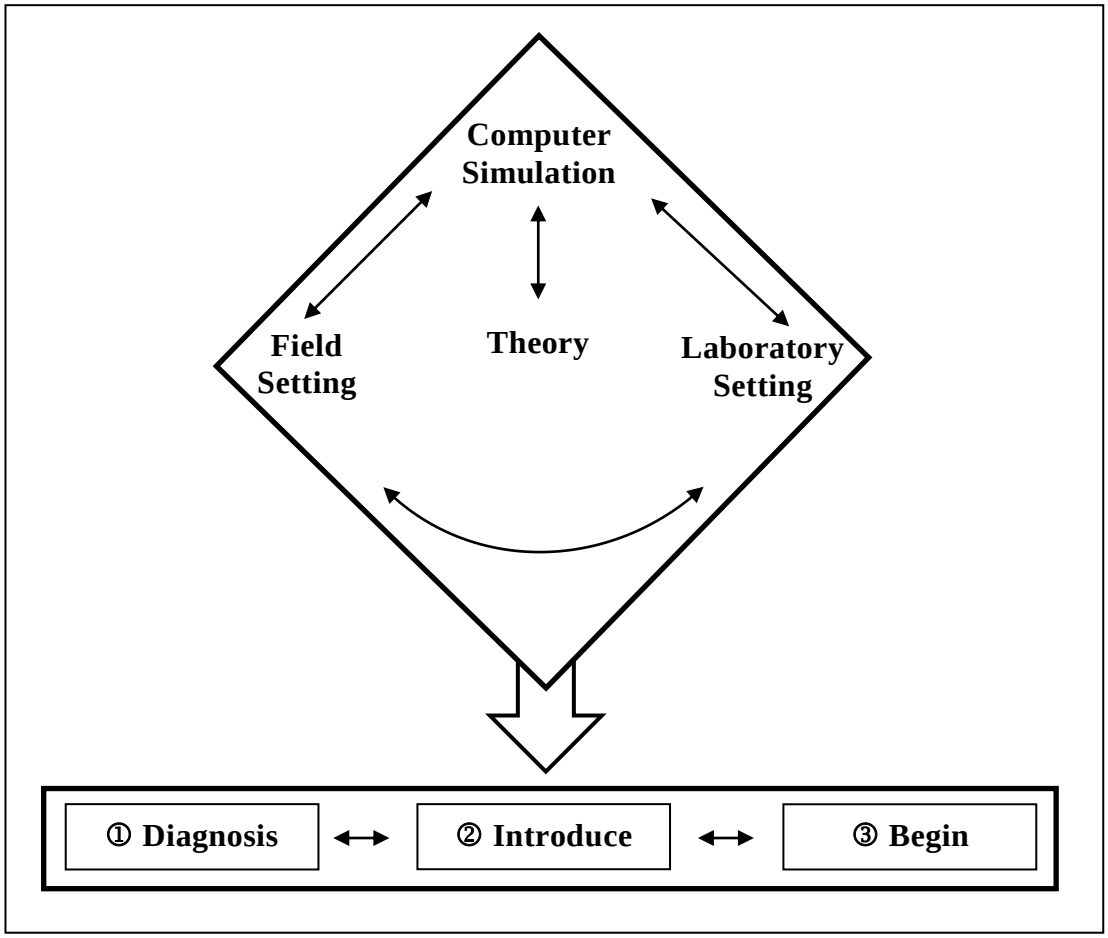
[264] Michael Bar-Eli, "Biofeedback as Applied Psychophysiology in Sport and Exercise", in **Brain and Body in Sport and Exercise: Biofeedback Applications in Performance Enhancement**, Eds. by Boris Blumenstein, Michael Bar-Eli, and Gershon Tenenbaum, (West Sussex: John Wiley & Sons, Ltd., 2002): 8-9.

[265] Inna Z. Khazan, **The Clinical Handbook of Biofeedback: A Step-by-Step Guide for Training and Practice with Mindfulness**, pp. 16-17.

Step 3: Once the client is able to stay with the present experience, begin teaching biofeedback skills with the focus on making mindful changes. As necessary, continue teaching your clients mindfulness practices that may further aid the biofeedback skills you are teaching. Refer to the troubleshooting section for ideas of practices that may be useful as issues come up in biofeedback training.[266]

From the steps presented as above, the following figure presents the framework of integrating mindfulness into your biofeedback practice[267]

Figure 4.6: The Framework of Integrating Mindfulness into Biofeedback Practice



[266] Op.cit.

[267] Adapted from B. D. Hatfield, D. M Landers, "Psychophysiology-A new direction for sport psychology", **Journal of Sport Psychology**, No. 5 (1983): 243-259; Ibid., pp. 16-17.

In addition to the above mentioned ways that are generally used in the biofeedback process, **Bin Yu**[268] has attempted interestingly to design "Natural Coupling" for biofeedback interaction in order to facilitate the user's understanding of physiological data.

In his design explorations, he practiced the idea of "Natural Coupling" in different interfaces which mainly focused on three aspects of Natural Coupling, namely: - (1) modality, (2) dynamics, and (3) expression;

Modality: Firstly, the sensory modality of biofeedback displays was selected to be in harmony with the user's somatic experience of a self-regulated physiological process. Taking breathing regulation as an example, the human respiration is accompanied by airflow, breath sound, and the expansion/contraction of the chest cavity. When we take deep breathes; our breathing movement can be seen, heard and felt by our senses. In LivingSurface (S2), the wind-driven actuation of the surface was designed to "mirror" the airflow of human breathing. The touch sense (tactile feedback) through the inflation/deflation of BwT enables users to feel the breathing guidance intuitively along with breathing regulation. The up and down of the wind sound in BioSoundscape is also in harmony with the breath sound.

Dynamics: Secondly, the dynamics of interface display (time, position, speed, force) are coupled to the dynamics of the represented physiological processes (respiration rate, heartbeat activities, IBI oscillation). The discrete heartbeat activities are coupled to the discrete vibrations of LivingSurface (S1). A smooth breathing movement makes LivingSurface (S3) bulge and flatten continuously, smoothly and rhythmically.

Expression: Thirdly, the expressions of interface display reflect the physiological processes or indicate the physiological meaning. In the metaphorical visualizations, the static expressions are related to the semantics of the created visual images. The heart rate level is reflected by

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[268] Bin Yu, "Designing Biofeedback for Managing Stress", **Doctor of Philosophy Dissertation (Industrial Design Department)**, (Graduate School: Eindhoven University of Technology, 2018), pp. 164-165.

the size of flower. The flexibility of heart rhythm is reflected by the shape of flower. The stress level is reflected by the appearance of the StressTree. In the other interfaces that present the physiological processes, the aspect of expression is closely related to the dynamics. In DeLight, the breathing movement is reflected by the brightness transferring between a far and a near light. In BioSoundscape, the arousal level is reflected by its richness.

4.2.5 Means of Biofeedback Process[269]

Biofeedback is categorized into two major categories,[270] namely:- 1.Physiological Biofeedback, and 2.Biomechanical Biofeedback. Firstly, physiological biofeedback is based on signals and parameters acquired from neuromuscular system, cardiovascular system, respiratory system, brain, skin, and other body systems.[271] Secondly, biomechanical biofeedback is based on signals and parameters acquired from the measurements of body or body part movements, body posture, and forces produced by the body or forces applied to the body.[272] Humans use the data from their body sensors and from the artificial sensors for perception that allows them to be aware of and to understand themselves and their environment. Perception is an essential element of the biofeedback process.[273]

Of such categories, biofeedback can thus be a powerful tool through which one can utilize psychophysiological training to further develop, promote, and refine the skills necessary for compassion. With practice, skills born of each modality not only become polished over time but also appear to have a reciprocally beneficial and additive effect. If we

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[269] See C. Gilbert, D. Moss, "Biofeedback and Biological Monitoring", in D. Moss, A. McGrady, T.C. Davies, I. Wickramasekera (eds.), **Handbook of Mind-body Medicine for Primary Care: Behavioral and Psychological Tools**, (Thousand Oaks: Sage Publications, 2003): 109-122; Timothy Culbert and Gerard A. Banez, "Pediatric Applications", in **Biofeedback: a Practitioner's Guide**, 4th ed. (2016): 643.

[270] O. M. Giggins; U. M. Persson; B. Caulfield, "Biofeedback in Rehabilitation, **J Neuroeng Rehabil**, Vol. 10 No. 1 (2013): 60.

[271] Desney Tan (ed.-in-chief), **Biomechanical Biofeedback Systems and Applications**, (Cham: Springer, 2018), p. 26.

[272] Op.cit.

[273] Ibid. p. 29.

combine conscious attention and focusing practices from traditional meditation with the precision that biofeedback training affords, then it is possible to change the habitual processes of the brain to function more effectively and perhaps efficiently.[274]

Therefore the means of biofeedback that are usually founded available nowadays, may be classified into 7 types depending on psychophysically and biomechanically, they are 1) Electromyography (EMG), 2) Electrodermograph (EDG), 3) Skin Temperature Thermography, 4) Blood Pulse Variability (BPV), 5) Heart Rate Variability (HRV), 6) Respiratory Sensors (RESP), and 7) Electroencephalography (EEG). The details are as follows.

1. Electromyography (EMG)[275]

Electromyography (EMG) is an experimental technique concerned with the development, recording and analysis of myoelectric signals. Myoelectric signals are formed by physiological variations in the state of muscle fiber membranes.[276] Electromyography (EMG) denotes the use of special instruments to measure the electrical activity of skeletal muscles.[277] It uses surface electrodes to detect muscle action potentials from underlying skeletal muscles. Therapists may use portable electromyographs and EMG telemetry systems to dynamically monitor muscle activity during training to correct gait, posture, and athletic and musical performance.[278]

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[274] Urszula Klich, "The Integration of Mindfulness-Based Biofeedback and Compassion in the Healthcare Setting", **Biofeedback,** Vol. 43 Issue 3 (Fall 2015): 111-116.

[275] Electromyography (EMG) including Surface Electromyography (sEMG).

[276] Peter Konrad, **The ABC of EMG: A Practical Introduction to Kinesiological Electromyography**, (Scottsdale: Noraxon INC., April 2005), p. 4.

[277] Mark S. Schwartz, Thomas F. Collura, Joe Kamiya, and Nancy M. Schwartz, "The History and Definitions of Biofeedback and Applied Psychophysiology", in **Biofeedback: a Practitioner's Guide**, 4th ed., (2016): 8.

[278] F. Shaffer and D. Moss, "Biofeedback", **Textbook of Complementary and Alternative Medicine**, 2nd ed., Eds. by C. S. Yuan, E. J. Bieber, B. A. Bauer, (Informa Healthcare, January 2006): 1-22.

In this procedure, the electrical changes in the muscle groups are transduced into electrical signals that are subsequently displayed to the patient. The patient then sees or hears the transformed EMG signals that are proportional to the degree of muscular activity. In additions, electromyography sensors measure electrical activity in the muscles, specifically muscle tension. In treating TMJ or bruxism, these sensors would be placed along the muscles of the jaw. Chronic pain might be treated by monitoring electrical energy in other muscle groups.[279]

In fact, human beings normally have voluntary control through the central nervous system over muscle activity. However, human beings have little experience in identifying and controlling many muscle groups. CD (cervical dystonia) patients often carry high level of tension in the neck and shoulders, yet often are not able to judge the level of tension. A surface EMG biofeedback device uses sensors placed on the surface of the skin to read the electrical activity in the muscle beneath the skin. The more electrical activity, the tenser the muscle group is. The biofeedback devise may use a meter to show the current level of tension, or send a signal with bar graph, a beeping sounder or a visual display on a computer screen. In each case, the person who receives immediate information about the level of tension in muscle group can learn to better assess the tension him or herself, and can also learn to relax the muscle. That process is helpful for CD patients, whose high muscle tension often worsens pain and abnormal postures.[280]

On the other hand, the electromyography (EMG), that has been discussed so far, in recent years, also called "surface electromyography" and sometimes abbreviated as sEMG.[281] As the modalities of biofeedback applications in order to optimal performance have utilized surface

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[279] Paula Anne Ford-Martin, "Biofeedback", **The GALE Encyclopedia of Medicine**, 4th Ed., ed. By Laurie J. Fundukian, (2011): 634.

[280] A. Jahanbazi, A. Chitsaz, K. Asgari, "Effects of EMG Biofeedback on Pain and Quality of Life in Cervical Dystonia", **J Neurol Disord**, Vol. 2 Issue 1 (2013): 144.

[281] Mark S. Schwartz, Thomas F. Collura, Joe Kamiya, and Nancy M. Schwartz, "The History and Definitions of Biofeedback and Applied Psychophysiology", in **Biofeedback: a Practitioner's Guide**, 4th ed., (2016): 18.

electromyography (sEMG) as a tool.[282] The wide range of methods and protocols used for EMG signal collection and analysis impairs the use of sEMG as an evaluation tool, as the comparison of data between subjects and between studies becomes limited.[283] This systematic review was conducted as a first step towards standardizing the methods used to record the sEMG of the respiratory muscles.[284]

A guideline describing items considered essentials to be reported in the description of EMG application in order to increase the methodological quality of the studies. This guideline was previously transformed into a checklist, and used to check the quality of the report presented by studies that applied sEMG.[285] An unfiltered (exception: amplifier bandpass) and unprocessed signal detecting the superposed MUAPs is called a raw EMG Signal. A raw surface EMG recording (sEMG) was done for three static contractions of the biceps brachii muscle.[286] Rissanen et al.[287] proposed using surface EMG with accelerometers, as surface EMG (sEMG) in diagnose idiopathic (PD)

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[282] Donald Moss and "Sue" Vietta Wilson, "The Use of General Biofeedback in the Pursuit of Optimal Performance", in **Case Studies in Applied Psychophysiology Neurofeedback and Biofeedback Treatments for Advances in Human Performance**, eds. By W. Alex Edmonds and Gershon Tenenbaum, (West Sussex: John Wiley & Sons, Ltd., 2012): 7.

[283] H.J. Hermens, B. Freriks, C. Disselhorst-Klug, G. Rau, "Development of Recommendations for SEMG Sensors and Sensor Placement Procedures", **J. Electromyogr. Kines**, Vol. 10 No. 5 (2000): 361-374.

[284] Ivanize Mariana Masselli Dos Reis, Daniela Gonçalves Ohara, Letícia Bergamin Januário, Renata Pedrolongo Basso-Vanelli, Ana Beatriz Oliveira, Mauricio Jamami, "Surface Electromyography in Inspiratory Muscles in Adults and Elderly Individuals: A Systematic Review", **Journal of Electromyography and Kinesiology**, Vol. 44 (February 2019): 139-155.

[285] L.B. Januario, R.F.C. Moreira, M.M. Cid, A. Samani, P. Madeleine, A.B. Oliveira, "Effects of Active Pause Pattern of Surface Electromyographic Activity among Subjects Performing Monotonous Tasks: A Systematic Review", **Journal of Electromyography and Kinesiology**, Vol. 30 (October 2016): 196-208.

[286] Peter Konrad, **The ABC of EMG: A Practical Introduction to Kinesiological Electromyography**, p. 10.

[287] S. Rissanen, M. Kankaanpää, A. Meigal, M. Tarvainen, J. Nuutinen, I. Tarkka, O. Airaksinen, P. Karjalainen, "Surface EMG and Acceleration Signals in Parkinson's Disease: Feature Extraction and Cluster Analysis", **Med. Biol. Eng. Comput**, Vol. 46 (2008): 849-858.

patients is characterized by alternating patterns. In this study, the EMG was collected from the biceps brachii (BB) muscle, and accelerometers were placed on the Palmer wrists. sEMG was also utilized by Loconsole et al.[288] for tremor detection. The Myo armbands were then attached to the forearms of the subjects.

More recently, the deployment of machine learning (ML) techniques in addition to wearable sensors has been evolving.[289] That is the use of wearable sensors; the application of machine learning (ML) techniques on the measured data has received increased attention by researchers in recent years. When machine learning (ML) techniques are combined with signal processing techniques, it helps to overcome some of the limitations and inaccuracies encountered during the measurement process using wearable sensors.[290] As several studies employed wireless wearable accelerometers and smartphones for the assessment of diagnose idiopathic (PD) tremor and simulated tremor, e.g., the study conducted by LeMoyne et al.[291] As Ahmed Baraka et al. suggested that wearable sensors such as accelerometers and surface EMG can provide potentially accurate and continuous measurements of health data through standardized human locomotion tests.[292]

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[288] C. Loconsole, G.D. Cascarano, A. Brunetti, G.F. Trotta; G. Losavio, V. Bevilacqua, E.D. Sciascio, "A Model-free Technique based on Computer Vision and sEMG for Classification in Parkinson's Disease by Using Computer-assisted Handwriting Analysis", **Pattern Recognit. Lett**., Vol. 121 (2019): 28-36.

[289] A.A. Badawi, A. Al-Kabbany, H. Shaban, "Multimodal Human Activity Recognition from Wearable Inertial Sensors Using Machine Learning", in **Proceedings of the 2018 IEEE-EMBS Conference on Biomedical Engineering and Sciences (IECBES)**, Sarawak, Malaysia, (3-6 December 2018), pp. 402-407.

[290] H. Jeon, W. Lee, H. Park, H.J. Lee, S.K. Kim, H.B. Kim, B. Jeon, K.S. Park, "Automatic Classification of Tremor Severity in Parkinson's Disease Using a Wearable Device, **Sensors**, Vol. 17 (2017): 2067.

[291] R. LeMoyne, T. Mastroianni, D. Whiting, N. Tomycz, "Traditional Ordinal Strategies for Establishing the Severity and Status of Movement Disorders, Such as Parkinson's Disease and Essential Tremor", in **Wearable and Wireless Systems for Healthcare II**, (Singapore: Springer, 2019), pp. 25-36.

[292] Ahmed Baraka, Heba Shaban, Mohamad Abou El-Nasr, and Omneya Attallah, "Wearable Accelerometer and sEMG-Based Upper Limb BSN for Tele-Rehabilitation", **Appl. Sci**., Vol. 9 (July 2019): 2795.

Therefore, EMG biofeedback gained solid support among researchers and clinicians[293] and can be used to deal with anxiety[294] on the basis that the levels of anxiety are significantly reduced simultaneously with the increasing levels of relaxation.

2. Electrodermograph (EDG)

An Electrodermograph (EDG)[295] or Electrodermal Activities (EDA)[296] measures skin electrical activity directly (skin conductance and skin potential) and indirectly (skin resistance) using electrodes placed over the digits or hand and wrist.[297] There are 3 types of measuring skin,[298] they are:- 1) Skin Conductance, 2) Skin Potential, and 3) Skin Resistance.

1. Skin Conductance: an electrodermograph imposes an imperceptible current across the skin and measures how easily it travels through the skin when anxiety raises the level of sweat in a sweat duct,

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[293] Mark S. Schwartz, Thomas F. Collura, Joe Kamiya, and Nancy M. Schwartz, "The History and Definitions of Biofeedback and Applied Psychophysiology", in **Biofeedback: a Practitioner's Guide**, 4th ed. (2016): 8.

[294] James Brik, "The Effects of EMG Biofeedback Training and Relaxation Training on Self-Reported Measures of Trait Anxiety and Sports Competition Anxiety", **Doctor of Education Thesis (Education)**, (Graduate School: Oregon State University, 1984), p. Abstract page.

[295] Timothy Culbert and Gerard A. Banez, "Pediatric Applications", in **Biofeedback: a Practitioner's Guide**, 4th ed. (2016): 643.

[296] "Electrodermal activity (EDA), electrodermal response (EDR), and electrodermal level (EDL) are general terms for either exosomatic or endosomatic phenomena. EDL refers to baseline levels; EDR refers to responses away from baselines; and EDA, the most general term, refers to levels and/or responses." - C. J. Peek, "A Primer of Traditional Biofeedback Instrumentation", in **Biofeedback: a Practitioner's Guide**, 4th ed. (2016): 56.

[297] F. Shaffer and D. Moss, "Biofeedback", **Textbook of Complementary and Alternative Medicine**, 2nd ed., (2006): 1-22.

[298] See J.T. Cacioppo, L.G. Tassinary, A.J. Fridlund, "The Skeletomotor System", in J.T. Cacioppo, L.G. Tassinary (eds.), **Principles of Psychophysiology: Physical, Social, and Inferential Elements**, (New York: Cambridge University Press, 1990): 325-384; M.E. Dawson, A.M. Schell, D.L. Filion, "The Electrodermal System", in J.T. Cacioppo, L.G. Tassinary, G.G. Berntson (eds.), **Principles of Psychophysiology**, 2nd ed. (New York: Cambridge University Press, 2000): 200-223.

conductancevincreases. Skin conductance is measured in microsiemens.[299]

2. Skin Potential: a therapist places an active electrode over an active site (e.g. the palmar surface of the hand) and a reference electrode over a relatively inactive site (e.g. forearm). Skin potential is the voltage that develops between eccrine sweat glands and internal tissues, and is measured in millivolts.[300]

3. Skin Resistance: also called galvanic skin response (GSR), an electrodermograph imposes a current across the skin and measures the amount of opposition it encounters. Skin resistance is measured in kohms.[301]

GSR is historically a universally recognized term for EDA, perhaps because the term has for a long time referred to a variety of exosomatic and endosomatic phenomena, and to both levels and responses. Although the term GSR will probably continue in widespread use, other terminology has been suggested that is more descriptive of specific electrodermal phenomena. Adopted from Venables and Christie (1980).[302]

It is a form of electrodermal activity-increased resistance of the skin to conducting tiny electrical currents because of reduced sweat and dryness. Older term less often used now, but still accepted. Opposite of "skin conductance" (SC).[303] GSR sensors are electrodes placed on the fingers that monitor perspiration, or sweat gland, activity.[304] At times of emotional activity, electrical reactions can be detected by electrodes on the surface of the skin. The correlation between the two forms the basis

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[299] Microsiemens refer to millionths of a Siemen.

[300] Millivolts refer to thousandths of a volt.

[301] Kohms refer to thousands of ohms.

[302] C. J. Peek, "A Primer of Traditional Biofeedback Instrumentation", in **Biofeedback: a Practitioner's Guide**, 4th ed. (2016): 56.

[303] Mark S. Schwartz, Thomas F. Collura, Joe Kamiya, and Nancy M. Schwartz, "The History and Definitions of Biofeedback and Applied Psychophysiology", in Ibid.: 18.

[304] Paula Anne Ford-Martin, "Biofeedback", **The GALE Encyclopedia of Medicine**, 4th Ed., ed. By Laurie J. Fundukian, (2011): 634.

for a Lie Detector test, though like all correlations one is still left guessing as to what it actually means.[305]

GSR can be also called electro-dermal response (EDR) or psychogalvanic reflex or response (PGR). GSR is a change in the electrical properties (conductance or resistance) of the skin in reaction to stimuli, owing to the activity of sweat glands located in the fingers and palms. Though strictly an indication of physiological arousal, the galvanic skin response is widely considered a reflection of emotional arousal and stress as well.[306] Electro-dermal measures is one of the modalities of biofeedback applications in order to optimal performance.[307]

3. Skin Temperature Thermography

Apart from the abovementioned EMG and EDG, the human's temperature can be utilized as a biofeedback tool for optimal performance.[308] Due to the fact that human body temperature is well established as one of the key vital signs, it is measured at regular intervals in the medical setting and often at home to try estimate the degree of "sickness" of an individual.[309] Gender differences in body temperature had been suspected to relate to a difference in body fat percentage between women and men. A number of studies revealed that women have a comparably larger percentage of body fat distribution subcutaneously, which in turn correlates with lower average skin temperatures.[310]

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[305] David A. Statt, **The Concise Dictionary of Psychology**, 3rd ed., p. 59.

[306] Gary R. VandenBos (ed. in Chief), **APA Dictionary of Psychology**, 2nd ed., (Washington, DC: American Psychological Association, 2015), p. 446.

[307] Donald Moss and "Sue" Vietta Wilson, "The Use of General Biofeedback in the Pursuit of Optimal Performance", in **Case Studies in Applied Psychophysiology Neurofeedback and Biofeedback Treatments for Advances in Human Performance**, (2012): 7.

[308] Op.cit.

[309] M.J. Kluger, W. Kozak, CA. Conn et al., "Role of Fever in Disease", **Ann N Y Acad Sci**, Vol. 856 (1998): 224-233.

[310] E B. Neves, A C. Salamunes, R M. De Oliveira, A M. Stadnik, "Effect of Body Fat and Gender on Body Temperature Distribution", **J Therm Biol**, Vol. 70 (2017): 1-8; A C. Salamunes, A M. Stadnik, E B. Neves, "The Effect of Body Fat Percentage and Body Fat Distribution on Skin Surface Temperature with Infrared Thermography, **J Therm Biol**, Vol. 66 (2017): 1-9.

In skin temperature biofeedback, a feedback thermometer detects skin temperature with a thermistor (temperature-sensitive resistor) that is usually attached to a finger or toe. Skin temperature mainly reflects arteriole diameter. Hand warming and hand cooling are produced by separate mechanisms and their regulation involves different skills. Increased sympathetic activation associated with anxiety and hyper vigilance can produce vasoconstriction and hand cooling.[311]

So the temperature biofeedback is about monitoring the changes in skin temperature that are caused by autonomic and endocrine activity. These changes are easier to detect in the peripheral circulation, so hands and feet are ideal locations.[312] Some of the temperature measurement may be implemented as a skin temperature measurement system. The system aims to measure the skin temperature from a sensor and send it to the PC using a USB cable to display on screen.[313] Romanovsky et al. state that skin temperature is one of the body's temperatures, and that thermal cutaneous signals serve as feedback signals in the thermoregulation system.[314] Temperature sensors, temperature, or thermal, sensors measure body temperature and changes in blood flow.[315]

As well-controlled studies have demonstrated that normal individuals provided with temperature feedback can voluntarily increase digital blood flow to produce reliable increases in skin temperature.[316] In

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[311] F. Shaffer and D. Moss, "Biofeedback", **Textbook of Complementary and Alternative Medicine**, 2nd ed., (2006): 1-22.

[312] Fredric Shaffer, Didier Combatalade, and Erik Peper, "A Guide to Cleaner Skin Temperature Recordings and More Versatile Use of Your Thermistor", **Biofeedback**, Vol. 44 Issue 3 (2016): 168-176.

[313] Siamak Sarjoghian, "Skin Temperature Measurement", **Project Report**, (Faculty of Engineering, Science and the Built Environment: London South Bank University, 2010), p. 4.

[314] A.A. Romanovsky, M.C. Almeida, A. Garami, A.A. Steiner, M.H. Norman, S.F. Morrison, K. Nakamura, J.J. Burmeister, T.B. Nucci, "The Transient Receptor Potential Vanilloid-1 Channel in Thermoregulation: A Thermosensor It is not", **Pharmacol Rev**, Vol. 61 (2009): 228-261.

[315] Paula Anne Ford-Martin, "Biofeedback", **The GALE Encyclopedia of Medicine**, 4th ed., Ed. By Laurie J. Fundukian, (2011): 634.

[316] Susan J. Middaugh, Jennifer A. Haythornthwaite, Bruce Thompson, Robin Hill, "The Raynaud's Treatment Study: Biofeedback Protocols and Acquisition

overall, the main thermoregulatory role of thermal cutaneous signals is to provide negative and positive auxiliary feedback to the thermoregulation system, thus both reducing the system's response time and making body temperature more stable. The outlined roles of cutaneous thermal signals are neither arbitrary nor a matter of linguistic preferences. They are deeply rooted in the dynamic functional architecture of the thermoregulatory system.[317] Taub (2010) reported his research with 11 participants attempting to alter skin temperature up or down on one digit compared to another. He reported that for eight subjects, there was "significantly greater temperature response on the designated digit than at the other one".[318]

In addition, the temperature biofeedback may be supported with blood volume pulse (BVP) feedback, which measures the relative blood flow through a digit using a photoplethysmographic (PPG) sensor attached by a Velcro band to the skin.[319] The researchers will further discuss this BVP in more details in the next topic.

4. Blood Pulse Variability (BPV)

In 2014, a study found positive correlation between increased BPV and carotid intima-media thickness.[320] Additionally, the movement of the carotid artery wall and various BPV parameters have been found to be affected by hypertension risk.[321] In an analysis of BPV during cold

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of Temperature Biofeedback Skills", **Applied Psychophysiology and Biofeedback**, Vol. 26 No. 4 (January 2002): 251-278.

[317] A. A. Romanovsky, "Skin temperature: Its Role in Thermoregulation", **Acta Physiol**, Vol. 210 (2014): 498-507.

[318] E. Taub, "What Psychology as a Science Owes Neal Miller: The Example of His Biofeedback Research", **Biofeedback**, Vol. 38 No. 3 (2010): 108-117.

[319] F. Shaffer and D. Moss, "Biofeedback", **Textbook of Complementary and Alternative Medicine**, 2nd ed., (2006): 1-22.

[320] H. Xiong, D. Wu, X. Tian, W-H. Lin, C. Li, H. Zhang, Y. Cai, Y-T. Zhang, "The Relationship Between the 24 H Blood Pressure Variability and Carotid Intima-media Thickness: A Compared Study", **Comput Math Methods Med**, (2014): 9.

[321] C. Xu, H. Xiong, Z. Gao, X. Liu, H. Zhang, Y. Zhang, X. Du, W. Wu, G. Liu, S. Li, "Beat-to-beat Blood Pressure and Two-dimensional (Axial and Radial) Motion of the Carotid Artery Wall: Physiological Evaluation of Arterial Stiffness", **Scientific Rep**, Vol. 7 (2017): 42254.

pressure test, subjects with predisposition to hypertension were found to have increased BPV.[322]

BP measurement manifests continuous fluctuations of BP, and BPV can be classified as very short-term BPV (beat-by-beat), short-term BPV (within 24 h), and long-term BPV (day-by-day, visit-to-visit).[323] Very short-term BPV and short-term BPV reflect increased central sympathetic drive, reduced arterial or cardiopulmonary reflex, and humoral and rheological factors. However, long-term BPV is associated with increased arterial stiffness, improper dosing or titration of antihypertensive medication, and poor medication compliance. Increased short-term and long-term BPV are associated with target organ damage such as cardiac, vascular, and renal damage and an increased incidence of cardiovascular events and mortality independent of mean BP level.[324]

Visit-to-visit blood pressure variability (BPV) is associated with cardiovascular events.[325] Higher visit-to-visit blood pressure variability (BPV)[326] is a predictor of cardiovascular events and all-causemortality,

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[322] D. Wu, L. Xu, D. Abbott, WK. Hau, L. Ren, H. Zhang, KK. Wong, "Analysis of Beat-to-beat Blood Pressure Variability Response to the Cold Pressor Test in the Offspring of Hypertensive and Normotensive Parents", **Hypertens Res**, Vol. 40 No. 6 (2017): 581.

[323] G. Parati, J. E. Ochoa, C. Lombardi, and G. Bilo, "Assessment and Management of Blood-pressure Variability", **Nature Reviews Cardiology**, Vol. 10 No. 3 (2013): 143-155; Yuichiro Yano, "Time Rate of 24-hour Blood Pressure Variability", **The Journal of Clinical Hypertension**, Vol. 19 Issue 11 (November 2017): 1078-1080.

[324] T. Kawai, M. Ohishi, K. Kamide et al., "The Impact of Visit-to-visit Variability in Blood Pressure on Renal Function", **Hypertension Research**, Vol. 35 No. 2 (2012): 239-243; A. M. Suchy-Dicey, E. R. Wallace, S. V. E. Mitchell et al., "Blood Pressure Variability and the Risk of All-cause Mortality, Incident Myocardial Infarction, and Incident Stroke in the Cardiovascular Health Study", **American Journal of Hypertension**, Vol. 26 No. 10 (2013): 1210-1217.

[325] Donald Clark, Stephen J. Nicholls, Julie St John, Mohamed B. Elshazly, Haitham M. Ahmed, Haitham Khraishah, Steven E. Nissen, Rishi Pur, "Visit-to-Visit Blood Pressure Variability, Coronary Atheroma Progression, and Clinical Outcomes", **JAMA Cardiol**, Vol. 4 No. 5 (2019):437-443.

[326] "Higher mean blood pressure (BP)" - Dong Hoon Shin, Soohwa Song, and Yeong Bae Lee, "Comparison of the Effect of Fimasartan versus Valsartan on Blood Pressure Variability in Acute Ischemic Stroke: A Double-Blind Randomized Trial", **Cardiovascular Therapeutics**, (June 2019): 1-8.

findings demonstrated across multiple cohorts over the last 20 years.[327] Let us now examine more on the next means of biofeedback process named Heart Rate Variability (HRV).

5. Heart Rate Variability (HRV)

Heart rate variability (HRV) is traditionally derived from RR interval time series of electrocardiography (ECG). Photoplethysmography (PPG) also reflects the cardiac rhythm since the mechanical activity of the heart is coupled to its electrical activity.[328] HRV is another biofeedback tool for optimal performance.[329] It can be defined as the beat-by-beat variations in one's heart rate.[330] A relatively new method of biofeedback based on heart rate variability (HRV) has emerged in recent years and may in fact serve to make biofeedback more accessible and user-friendly.[331]

In Heart Rate Variability Biofeedback (HRV-Biofeedback) or Heart rate variability biofeedback training,[332] the variability of heart rate is measured in a number of ways, such as the statistical variability of the inter-beat interval (the length of time between each heart beat).

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[327] J. Wang, X. Shi, C. Ma et al., "Visit-to-visit Blood Pressure Variability is a Risk Factor for All-cause Mortality and Cardiovascular Disease: A Systematic Review and Meta-analysis", **J Hypertens**, Vol. 35 No. 1 (2017): 10-17.

[328] N. Selvaraj, A. Jaryal, J. Santhosh, K. K. Deepak, S. Anand, "Assessment of Heart Rate Variability Derived from Finger-tipphotoplethysmography as Compared to Electrocardiography", **Journal of Medical Engineering & Technology**, Vol. 32 No. 6 (July 2008): 479-484.

[329] Donald Moss and "Sue" Vietta Wilson, "The Use of General Biofeedback in the Pursuit of Optimal Performance", in **Case Studies in Applied Psychophysiology Neurofeedback and Biofeedback Treatments for Advances in Human Performance**, (2012): 7.

[330] A. Schwerdtfeger and P. Friedrich-Mai, "Social Interaction Moderates the Relationship between Depressive Mood and Heart Rate Variability: Evidence from an Ambulatory Monitoring Study", **Health Psychology**, Vol. 28 (2009): 501-509.

[331] Paul Ratanasiripong; Kevin Sverduk, Judy Prince, Diane Hayashino, "Biofeedback and Counseling for Stress and Anxiety among College Students", **Journal of College Student Development**, Vol. 53 No. 5 (September/October 2012): 742-749.

[332] Ingrid Pirker-Binder (ed.), **Mindful Prevention of Burnout in Workplace Health Management: Workplace Health Management, Interdisciplinary Concepts, Biofeedback**, (2017): 214.

Alternatively, biofeedback can measure the difference between the maximum heart rate and the minimum heart rate in each cycle of heart rate change. In either case, the variability of heart rate correlates with both physical and emotional health[333]

There are numerous randomized clinical trials being performed with the StressEraser to assess the impact of the device as a stand-alone or adjunctive intervention for primary insomnia, generalized anxiety disorder, posttraumatic stress disorder, depression, cardiac rehabilitation, performance anxiety, and general stress levels. Most of these trials include both subjective (e.g., self-report) and objective (e.g., HRV and/or electroencephalogram) psychophysiological parameters.[334]

HRV might be an index of self-regulatory strength[335] as well as to cultivating enhanced self-awareness.[336] It has been suggested that stress and negative affect can be improved through adaptive emotion regulation,[337] which is a form of self -regulation that is expressed through certain physiological measures, especially HRV.[338]

Therefore, HRV biofeedback is the essential means of mind-body medicine and should be a regular fixture in the clinician's tool box. Heart rate sensors, a pulse monitor placed on the fingertip can monitor

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[333] F. Shaffer and D. Moss, "Biofeedback", **Textbook of Complementary and Alternative Medicine**, 2nd ed., (2006): 1-22.

[334] Frederick Muench, "The Portable StressEraser Heart Rate Variability Biofeedback Device: Background and Research", **Biofeedback**, Vol. 36 Issue 1 (Spring 2008): 35-39.

[335] S.C. Segerstrom and L.S. Nes, "Heart Rate Variability Reflects Self-regulatory Strength, Effort, and Fatigue", **Psychological Science**, Vol. 18 (2007): 275-281.

[336] S. Kim, J.F. Rath, R. McCraty, V. Zemon, M.M. Cavallo, F.W. Foley, "Heart Rate Variability Biofeedback, Self-regulation, and Severe Brain Injury", **Biofeedback**, Vol. 43 (2015): 6-14.

[337] J.J. Gross, "Emotion Regulation: Affective, Cognitive, and Social Consequences", **Psychophysiology**, Vol. 39 (2002): 281-291; S.G. Hofmann, "Interpersonal Emotion Regulation Model of Mood and Anxiety Disorders", **Cognitive Therapy and Research**, Vol. 38 (2014): 483-492.

[338] V. C. Goesslt, J. E. Curtisst and S. G. Hofmann, "The Effect of Heart Rate Variability Biofeedback Training on Stress and Anxiety: A Meta-analysis", **Psychological Medicine**, (Cambridge University Press, March 2017): 1-9.

pulse rate.[339] Esther I. de Bruin; J. Esi van der Zwan; and Susan M. Bögels claimed that daily mindfulness meditations (MM), daily heart rate variability biofeedback (HRV-BF), and daily physical exercise (PE) are all effective self-help methods to improve attention control, executive functioning, mindful awareness, self-compassion, and worrying[340]

The heart rate variability biofeedback does significantly improve heart rate variability as well as some certain actions which require concentration as a based [shooting accuracy in secondary school shooters].[341] Besides, anxiety had tendency to decrease in somatic and cognitive anxiety and self-confidence had tendency to increase**.**

6. Respiratory Sensors (RESP)

Respiration may also be utilized as a biofeedback tool for optimal performance.[342] The human respiratory system operates 24 hours a day and continues throughout the life of a living organism until it dies.

A Pneumography (PNG)[343] or respiratory strain gauge uses a flexible sensor band that is placed around the chest, abdomen, or both. The strain gauge method can provide feedback about the relative

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[339] Paula Anne Ford-Martin, "Biofeedback", **The GALE Encyclopedia of Medicine**, 4th ed., Ed. By Laurie J. Fundukian, (2011): 634.

[340] Esther I. de Bruin; J. Esi van der Zwan; and Susan M. Bögels, "A RCT Comparing Daily Mindfulness Meditations, Biofeedback Exercises, and Daily Physical Exercise on Attention Control, Executive Functioning, Mindful Awareness, Self-Compassion, and Worrying in Stressed Young Adults", **Mindfulness**, Vol. 7 (2016): 1182–1192.

[341] Taychapat Makkong and Silapachai Suwantada, "Effects of Biofeedback Training Program on Anxiety and Shooting Accuracy of Secondary School Shooters" (Thai Version), **Journal of Sports Science and Health**, Vol.16 No.2, (May-August 2015): 14-24.

[342] Donald Moss and "Sue" Vietta Wilson, "The Use of General Biofeedback in the Pursuit of Optimal Performance", in **Case Studies in Applied Psychophysiology Neurofeedback and Biofeedback Treatments for Advances in Human Performance**, (2012): 7.

[343] Pneumograph.

expansion/contraction of the chest and abdomen, and measure respiration rate.[344]

The biofeedback process has utilized the concept of human respiration wisely. Measurement of respiratory rate is a vital sign. The respiratory sensors monitor oxygen intake and carbon dioxide output."[345] Next is the last type of biofeedback means that is often seen in the treatment, which is Electroencephalography (EEG).

7. Electroencephalography (EEG)

Electroencephalography (EEG) is another biofeedback tool that has been extensively utilized for Optimal Performance.[346] Electroencephalograph, a machine for recording the continuous electrical activity of the brain, usually through electrodes attached to the scalp. This activity is recorded on paper as brain waves of different frequency. [347]

This particular type of biofeedback that employs electroencephalography (EEG) into the process is alternatively called "neurofeedback". It is an electroencephalograph that uses precious metal electrodes to detect a voltage between at least two electrodes located on the scalp, The EEG records both excitatory postsynaptic potentials (EPSPs) and inhibitory postsynaptic potentials (IPSPs) that largely occur in dendrites in pyramidal cells located in macrocolumns, several millimeters in diameter, in the upper cortical layers.[348]

The ascent of neuroscience is often attributed primarily to technological developments and the maturation of a young discipline. Neuroscience today employs a variety of sophisticated research

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[344] F. Shaffer and D. Moss, "Biofeedback", **Textbook of Complementary and Alternative Medicine**, 2nd ed., (2006): 1-22.

[345] Paula Anne Ford-Martin, "Biofeedback", **The GALE Encyclopedia of Medicine**, 4th Ed., ed. By Laurie J. Fundukian, (2011): 634.

[346] Donald Moss and "Sue" Vietta Wilson, "The Use of General Biofeedback in the Pursuit of Optimal Performance", in **Case Studies in Applied Psychophysiology Neurofeedback and Biofeedback Treatments for Advances in Human Performance**, (2012): 7.

[347] David A. Statt, **The Concise Dictionary of Psychology**, 3rd ed., p. 46.

[348] F. Shaffer and D. Moss, "Biofeedback", **Textbook of Complementary and Alternative Medicine**, 2nd ed., (2006): 1-22.

technologies, including single-unit recording, electroencephalography (EEG), magnetoencephalography (MEG), functional magnetic resonance imaging (fMRI), positron emission tomography (PET), and transcranial magnetic stimulation (TMS). Lesion studies, animal models, and pharmacological manipulations are also common.[349]

Since the 1960s, neuroscientists have studied the physiological effects of meditation, often on Zen practitioners, using various devices (EEG, MRI, etc.) with intriguing results; such studies indicate that meditative states differ markedly from other mental states such as hypnosis, sleep, or catatonia. The "calm awareness" meditators achieve has measurable effects (lowered blood pressure, reduced respiration), and long-time practice "rewires" the brain in beneficial ways.[350]

Neurofeedback intended to enable people to alter their brain waves by using information from a video display or auditory signal of electroencephalograph (EEG) recordings of their brain-wave characteristics. Neurofeedback has been used with mixed results in the treatment of attention-deficit/hyperactivity disorder and epilepsy and is being investigated as a possible intervention for other conditions as well (e.g., headaches, insomnia, anxiety). It is also called EEG biofeedback, neurobiofeedback, or neurotherapy.[351] With electroencephalography (EEG) sensors, these electrodes are applied to the scalp to measure the electrical activity of the brain, or brain waves.[352]

In the case where the quantitative parameter is obtained from the brain electrical activity (e.g., EEG), it is then defined as EEG-

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[349] Mathis Kaiser and John Cromby, "Neuroscience", in **Encyclopedia of Critical Psychology**, ed. by Thomas Teo, (New York: Springer Science and Business Media, 2014): 1243.

[350] John Thompson, "Buddhism's Mahāyāna: Meditation", in **Encyclopedia of Psychology and Religion**, 2nd ed. by David A. Leeming, (New York: Springer Science and Business Media, 2014): 226-231.

[351] Gary R. VandenBos (ed. in Chief), **APA Dictionary of Psychology**, 2nd ed., p. 702.

[352] Paula Anne Ford-Martin, "Biofeedback", **The GALE Encyclopedia of Medicine**, 4th Ed., ed. By Laurie J. Fundukian, (2011): 634.

biofeedback, neurofeedback, learned cortical self-regulation[353], or operant brain regulation.[354] While therapeutic applications of EEG-biofeedback are commonly referred as neurotherapy[355]. The integrative indices obtained from electroencephalogram (EEG) and electrocardiogram benefit for diagnosis and therapy evaluation.[356] Erik Peper[357] explains in his research:

> Neurofeedback records the brainwaves (EEG: electroencephalography) and can selectively feedback certain EEG patterns. In most cases participants are unaware of subtle physiological changes that can occur. However, when the physiological signals are displayed so that the person can see or hear the changes in their physiology they learn internal awareness that is associated with these physiological changes and learn mastery and control. Biofeedback and neuro feedback is a tool to make the invisible, visible; the unfelt, felt and the undocumented, documented. Biofeedback can be used to document that a purported yoga practice actually affects the psychophysiology.

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[353] B. Rockstroh, T. Elbert, N. Birbaumer, P. Wolf, A. Düchting-Röth, M. Reker, I. Daum, W. Lutzenberger, and J. Dichgans, "Cortical Self-regulation in Patients with Epilepsies," **Epilepsy Research**, Vol. 14 (1993): 63-72; B. Kotchoubey, D. Schneider, H. Schleichert, U. Strehl, C. Uhlmann, V. Blankenhorn, W. Fröscher, and N. Birbaumer, "Self-regulation of Slow Cortical Potentials in Epilepsy: A Retrial with Analysis of Influencing Factors," **Epilepsy Research**, Vol. 25 (1996): 269-276; B. Kotchoubey, V. Blankenhorn, W. Fröscher,U. Strehl, and N. Birbaumer, "Stability of Cortical Self-regulation in Epilepsy Patients", **Neuro Report**, Vol. 8 (1997): 1867-1870.

[354] N. Birbaumer, "Selbstregulation langsamer Hirnpotentiale," **Neuroforum**, vol. 2 (1998): 190-203; N. Birbaumer, "Slow Cortical Potentials: Plasticity, Operant Control, and Behavioral Effects", **The Neuroscientist**, Vol. 5 No. 2 (1999): 74-78.

[355] T. Brownback and L. Mason, "Neurotherapy in the Treatment of Dissociation," in J. R. Evans and A. Abarbanel (eds.), **Introduction to Quantitative EEG and Neurofeedback**, (California: Academic Press, 1999): 145-156.

[356] Mehmet Eylem Kirlangic, "EEG-Biofeedback and Epilepsy: Concept, Methodology and Tools for (Neuro) therapy Planning and Objective Evaluation", **Doctor of Engineering Dissertation**, p. iii.

[357] Erik Peper, "Enhancing Yoga with Biofeedback", **Journal of Yoga and Physiotherapy**, Vol. 2 Issue. 2 (2017): 1-4.

EEG feedback or neurofeedback refers to the measurement of brainwaves, which are split up according to frequency components and fed back to the computer screen. The individual frequency components are allocated to different states of attention or consciousness, measured and submitted to training.[358]

Brain waves spontaneous, rhythmic electrical impulses emanating from different areas of the brain. Electroencephalographic brain-wave recordings are used to study sleep stages and cognitive processes. According to their frequencies, brain waves are classified as

Alpha waves (8-12 Hz),

Beta waves (13-30 Hz),

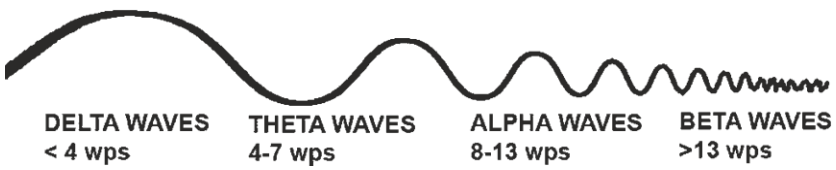
Delta waves (1-3 Hz),

Gamma waves (31-80 Hz), or

Theta waves (4-7 Hz).

The first substantial account of brain waves was given in 1929 by German neuropsychiatrist Hans Berger (1873-1944).[359]

Figure 4.7: Human Brain Wave Frequencies (in waves per second, or Hz)



Source: Thomas D. Parsons et al: 33.

[358] Ingrid Pirker-Binder (ed.), **Mindful Prevention of Burnout in Workplace Health Management: Workplace Health Management, Interdisciplinary Concepts, Biofeedback**, (2017): 200.

[359] Gary R. VandenBos (ed. in Chief), **APA Dictionary of Psychology**, 2nd ed., pp. 143-144.

That is, electroencephalography (EEG) is a way to pick up and record the different rhythmic patterns of brain activity, using electrodes placed on the scalp. The main brainwave patterns have been named based on the Greek alphabets, namely: alpha, beta, gamma, delta and theta in the same way as they were used by Johannes Bayer[360] around the year 1600 to name the brighter stars. Bayer, who created the Uranometria,[361] the greatest pre-modern star atlas, applied lowercase Greek letters to stars within a constellation.[362] The said Greek alphabets are as shown in the following Table.

Table 4.5: The Greek Alphabet

Alphabet	Lower case	Upper case	Alphabet	Lower case	Upper case
Alpha	α	A	**Nu**	ν	N
Beta	β	B	**Xi**	ξ	Ξ
Gamma	γ	Γ	**Omicron**	o	O
Delta	δ	Δ	**Pi**	π	Π
Epsilon	ε	E	**Rho**	ρ	P
Zeta	ζ	Z	**Sigma**	$\sigma\, \varsigma$	Σ
Eta	η	H	**Tau**	τ	T
Theta	$\theta\, \vartheta$	Θ	**Upsilon**	υ	Y
Iota	ι	I	**Phi**	φ	Φ
Kappa	κ	K	**Chi**	χ	X
Lambda	λ	Λ	**Psi**	ψ	Ψ
Mu	μ	M	**Omega**	ω	Ω

Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

Firstly, **Alpha wave** denotes a high-amplitude electroencephalogram (EEG) wave of brain electric activity of 8-12 hertz which is often found in relaxed individuals whose eyes are closed. It is

[360] Bayer, Johann, 1572-1625.

[361] Uranometria is the short title of a star atlas produced by Johann Bayer. It was published in Augsburg in 1603 by Christoph Mang (Christophorus Mangus). See Johann Bayer, **Uranometria**, (Latin; Greek Version), (Augsburg: Christophorus Mangus, 1603), p. A.

[362] James B. Kaler, **The Little Book of Stars**, (New York: Springer-Verlag, 2001), p. 89.

also called an alpha rhythm.[363] The first human EEG recording was obtained by Hans Berger in 1924. Berger's early work resulted in identifying what he referred to as "first-order waves" oscillating at a rate of 10 cycles per second or 10 Hz (now known as alpha waves).[364] While **Beta wave** denotes a pattern of electrical activity in the brain characteristic of normal, awake alertness as measured by an electroencephalograph, normally between 12 and 40 Hz.[365] It is known as "second-order waves" or beta waves oscillating at about 20-30 Hz.[366] Next, the **Delta wave** denotes a high-amplitude, low-frequency wave (1-3 Hz) of electrical activity in the brain measured by electroencephalography which is characteristic of deep, dreamless sleep.[367] Then, **Gamma wave** is a pattern of neural oscillation in humans with a frequency between 25 and 100 Hz, though 40 Hz is typical.[368] And last, the **Theta wave** refers to frequency components in the 4-7 Hz range, regardless of their source**.**

EEG is a popular neuroimaging technique that measures electrical activity produced by the brain via electrodes that are placed on the scalp. These measurements vary predictably in response to changing levels of cognitive stimuli.[369] It is a method that records electrical activity in the brain using special electrodes placed on the scalp; functional magnetic resonance imaging (fMRI), a method that detects changes in the activity of the brain by measuring the amount of oxygen brought to a

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[363] David Matsumoto (gen. ed.), **The Cambridge Dictionary of Psychology**, (Cambridge: Cambridge University Press, 2009), p. 30.

[364] Thomas D. Parsons, Lin Lin, Deborah Cockerham (eds.), **Mind, Brain and Technology Learning in the Age of Emerging Technologies**, (Cham: Springer, 2019), p. 33.

[365] David Matsumoto (gen. ed.), **The Cambridge Dictionary of Psychology**, p. 82.

[366] Thomas D. Parsons, Lin Lin, Deborah Cockerham (eds.), **Mind, Brain and Technology Learning in the Age of Emerging Technologies**, p. 33.

[367] David Matsumoto (gen. ed.), **The Cambridge Dictionary of Psychology**, p. 153.

[368] Ian Gold, "Does 40-Hz Oscillation Play a Role in Visual Consciousness?", **Consciousness and Cognition**, Vol. 8 No. 2 (1999): 186-195.

[369] P. Antonenko, D. Niederhauser, "The Influence of Leads on Cognitive Load and Learning in a Hypertext-assisted Learning Environment", **Computers in Human Behavior**, Vol. 26 No. 2 (2010): 140-150.

particular location within it; and transcranial magnetic stimulation (TMS), a method in which the functioning of a specific area of the brain is temporarily disrupted through the application of pulsating magnetic fields to the skull using a stimulating coil.[370] Ven. Khenpo Phuntsho Gyaltshen gives a view towards the biofeedback instruments:

> In the Buddha's time these things cannot be proven. But with the advanced technology, such sophisticated equipment's and tools have been invented recently as a result of human's curiosity. They do have the finding tools to detect what is actually happening during Buddhist meditation. . . I find one thing very important that biofeedback is making a progressive substantiation of the Buddhist teachings.[371]

Pahalawattage Don Premasiri gives a consistent opinion that "There is a close connection between the body and the mind in order to develop the human development. These things, they have been attributed the study closely by neuroscientists now."[372]

In conclusion, the functional tools that biofeedback process usually used in the present are of Seven types, they are:- Electromyography-EMG; Electrodermograph-EDG; Skin Temperature Thermography; Blood Pulse Variability-BPV; Heart Rate Variability-HRV; Respiratory Sensors-RESP; and Electroencephalography-EEG. They may be displayed in the following figure.

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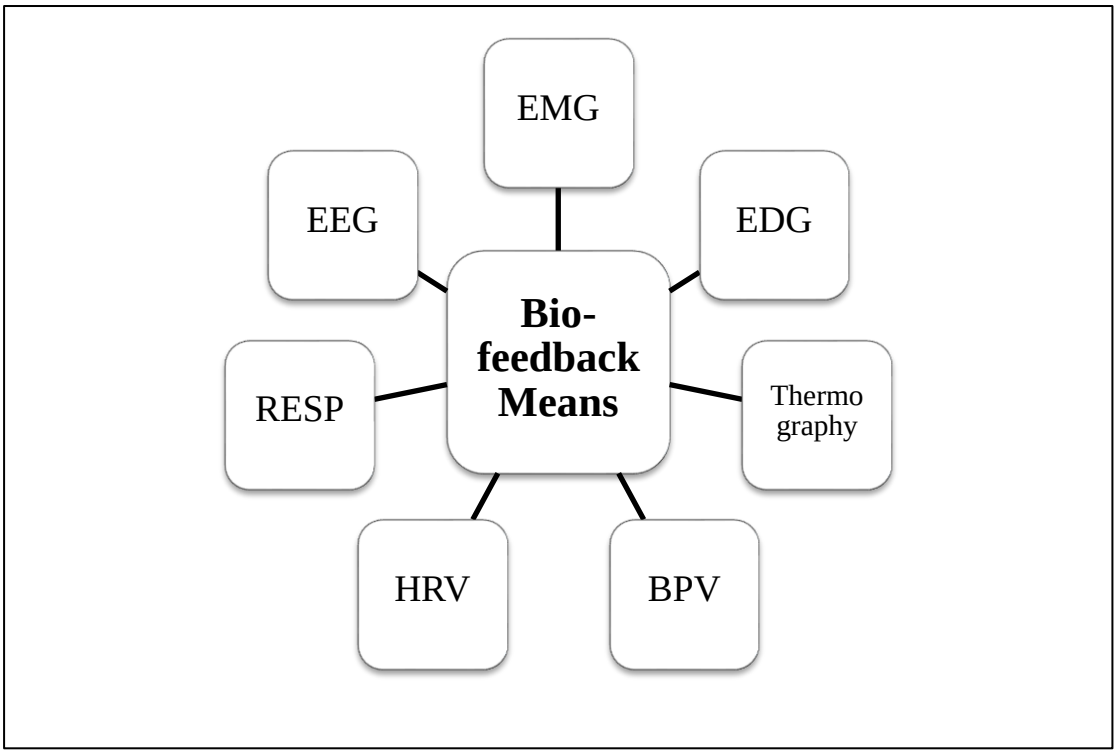
[370] Aidan Moran, "Attention Theory", in **Encyclopedia of Sport and Exercise Psychology**, eds. by Robert C. Eklund and Gershon Tenenbaum, (Los Angeles: SAGE Publications, Inc., 2014): 39-42.

[371] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

[372] Interview with Em. Prof. Dr. Pahalawattage Don Premasiri, University of Peradeniya, Sri Lanka, Jan 26, 2019.

Figure 4.8: Seven Types of Functional Tools Used in Biofeedback Process



Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

From the surveys of important tools that biofeedback employed in the treatments, we can clearly see that those tools are all used detecting various signals of the system within the human body, in order to make mind-body communication possible. However, the following table summarizes the basic means of biofeedback process together with its parameters and practical applications.

Table 4.6: Basic Biofeedback Means, Parameters and Applications[373]
(Source: Sanu Mahatthanadull et al.)

Means	Parameters	Applications
1. EMG-Electromyography	Muscle tension	The more stressed one is, the tighter one's muscles are.
2. EDG-Electrodermograph	Sweat gland activity	The more excited or stressed one feels, the more sweat glands open up on the surface of one's palms.
3. Skin Temperature Thermography	Hand/finger warmth	The more relaxed one is, the warmer one's hands and fingers get.
4. BPV- Blood Pulse Variability	Heart rate	The more excited, scared or angry one is, the faster one's heart beats.
5. HRV- Heart Rate Variability	Heartbeat pattern	When one is excited, scared, or angry, one's heartbeat pattern is more random. When one is in a better balance in mind and body, one's heartbeat pattern gets more rhythmical and looks like "rolling waves."
6. RESP- Respiratory Sensors	Breathing	When one breathes in, the belly should get bigger; when one breathes out it should flatten out again.
7. EEG-Electroencephalography	Brain waves	Our brain creates electrical impulses. Some are faster (beta waves), others are slower (alpha and theta waves), and some are seen during sleep (delta waves).

Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

From the table, these unique scientific measurement instruments may be used for a variety of purposes even for behavioral improvements of patients with wheelchairs. Biofeedback revealed a viable means of improving propulsion technique of wheelchair users. Participants were able to make significant and controlled changes to both single and multi-variables biofeedback.[374] Moreover, for the purpose of mental-quality improvements, biofeedback can also be used as a means to reduce the

[373] Adapted from Timothy Culbert and Gerard A. Banez, "Pediatric Applications", in **Biofeedback: a Practitioner's Guide**, 4th ed. (2016): 643.

[374] Liyun Guo, "Development and Testing of a Biofeedback System for Wheelchair Propulsion Analysis", **Doctor of Philosophy Dissertation (Mechanical Engineering)**, (Faculty of the Graduate School: Vanderbilt University, 2012), pp. 68, 73-74.

anxiety as the **Catherine Andrea Prato**'s research findings[375] revealed that the subjective test anxiety scores of the students did not decrease by the end of the biofeedback assisted relaxation training program. The students were able to learn how to control their respiratory rate, and as a result peripheral skin temperatures increased significantly during each training session. The training strategy that resulted in the greatest change in physiological measures, and presented the most significant findings was the autogenic training session.

Table 4.7: The Ends, Ways and Means of Biofeedback Process

	Biofeedback
Ends	1. To entrain successive changes in performance and ability to self-regulate. 2. To increase awareness of self in relation to the world, 3. To reduce the stress levels for relaxation. 4. To cure the diseases. 5. To improve the levels of physical performance. 6. To obtain contemplation and wisdom.
Ways	1. Psycho-physiological Training Method. 2. Meditation Relaxation.
Means	1. Electromyography (EMG). 2. Electrodermograph (EDG). 3. Skin Temperature Thermography. 4. Blood Pulse Variability (BPV). 5. Heart Rate Variability (HRV). 6. Respiratory Sensors (RESP). 7. Electroencephalography (EEG).

Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

From the above table, biofeedback reflects the multiple goals that are ranging from the self-regulation to the intellectual dimension are the human's highest knowledge called wisdom. Then the ways that biofeedback alternatively used covering both the psycho-physiological

[375] Catherine Andrea Prato, "Biofeedback assisted relaxation training program to decrease test anxiety in nursing students", **Doctor of Philosophy (Nursing) Dissertation**, (Graduate College: University of Nevada, 2009), p. iii-v.

method where the mind-body concept is wisely focused; and the meditation relaxation where a spiritual training is used as a practical method. Lastly the various means that biofeedback used, a skillful means, obviously depicted highly effective measuring instruments in which they are accurate and reliable in order to measure various signals and parameters caused by physiological and psychological phenomena of human beings.

In conclusion, the theory of biofeedback preliminary originated during the mid-20th century in 1961, under the claimed that the human's autonomic processes were surprisingly controllable. Later on, the said theory has been continuously developed until the present time which is an era in which technological progress has been evolutionary fulfilled to the maximum capacity. While Biofeedback refers to a therapeutic procedures or a patient-guided treatment in the Applied Psychophysiology that employs a physiological responses process technique whereby a subject's mind is trained to gain some element of voluntary control over certain bodily functions that are normally unconsciously regulated by the autonomic nervous system (ANS). It is a closed feedback loop mechanism or a servo system which controls a biological process where the hypothalamus is alerted to abnormal biochemical levels. The essence is to use instruments that make the body's signals decodable to the mind. The biological signals that are fed back to the subject in order for the subject to develop techniques of manipulating them. The Ends of Biofeedback Process thus signify six different dimensions, namely:- (1) to entrain successive changes in performance and ability to self-regulate, (2) to increase awareness of self in relation to the world, (3) to reduce the stress levels for relaxation, (4) to cure the diseases, (5) to improve the levels of physical performance, and (6) to obtain contemplation and wisdom. While the Ways of Biofeedback Process represent the two different methods, namely: - (1) Psycho-physiological Training Method, and (2) Meditation Relaxation. Then the Means of Biofeedback Process deal with the skillful means concept of using the seven highly effective measuring instruments, namely: - (1) Electromyography (EMG), (2) Electrodermograph (EDG), (3) Skin Temperature Thermography, (4)

Blood Pulse Variability (BPV), (5) Heart Rate Variability (HRV), (6) Respiratory Sensors (RESP), and (7) Electroencephalography (EEG).

4.3 A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process

In this topic, the research team presents the conceptual model of Bi-Dimensional Development. The following four step-by-step sequences are discussed: - 1) Pre-Integration Information, 2) Advantage and Restriction Analysis of the Buddhist Principles on the Happiness Access and GNH, 3) Advantage and Restriction Analysis of the Biofeedback Theory, and 4) A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process.

4.3.1 Pre-Integration Information

The United Nations announced for the United Nations Strategic Model[376] in which it has been developed using happiness, peace and well-being as indices and indicators for human development. Particularly in the sustainable development goal indicator; Goal no. 16 Indicates an aim to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

Sauwalak Kittiprapas also proposed the Buddhist Sustainable Development (BSD) refers to human-centered sustainable development which is driven by inner happiness in an individual level. This type of development focuses on inner happiness, developed along the path towards highest life's goal of liberalization as well as appropriate systems allowing middle-way of life and middle-way economy. The relationship of human, social, economic, and environment in this system can use less

[376] The United Nations Development Programme, **Human Development Indices and Indicators 2018 Statistical Update**, (New York: UNDP, 2018), pp. 1, 109, 111.

quantity and increase quality of natural resources. This is a pathway towards real sustainable development.[377]

From the study of the concept of happiness access both from Theravada Buddhism and the concept of Vajrayāna GNH, it is found that the information is divided into two sets, which are 1) Ground knowledge is the basic body of knowledge, and 2) Knowledge for integration is the body of knowledge that is further used to create the Conceptual Model. They are,

a. Happiness in the Concentration

This type of happiness is a phenomenon that only occurs in the human mind where it is well developed.

It also results in higher levels of happiness are an intellectual phenomenon that occurs when human wisdom is developed completely.

The content consists of the fivefold happiness. They are: - (1) *pāmojja*, (2) *pīti*, (3) *passaddhi*, (4) *sukha*, and (5) *samādhi*.

b. Practices of Happiness Access

Accessing to the happiness according to Theravada Buddhism practice relies on the different patterns which are firstly through the dimension of psychological development. Secondly, happiness access through the dimension of intellectual development. And, thirdly, happiness access through the dimension of achieving higher happiness.

The content consists of the threefold practice, namely: - (1) Mental Development (*dhammasamādhi*), and (2) Wisdom Development.

c. Practices of GNH

The GNH Vajrayāna Buddhist Practices take into account the various dimensions that cover society, economy, environment, culture and governance.

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[377] Sauwalak Kittiprapas, "Buddhist Approach and Happiness for Sustainable Development", **The Journal of International Buddhist Studies College (JIBSC)**, Vol.1 No.1 (2015): 107-145.

The content consists of the fourfold practice, namely: - (1) Sustainable and Equitable Social and Economic Development, (2) Environmental Conservation, (3) Cultural Preservation and Promotion, and (4) Good Governance.

d. Means of Biofeedback Process

Biofeedback process offers a number of highly effective measuring tools which can work well with the Buddhist mind-body development process.

The content consists of the sevenfold means, namely: - (1) Electromyography-EMG, (2) Electrodermograph-EDG, (3) Skin Temperature Thermography, (4) Blood Pulse Variability-BPV, (5) Heart Rate Variability-HRV, (6) Respiratory Sensors-RESP, and (7) Electroencephalography-EEG.

The pre-integration information is therefore listed in the following table.

Table 4.8: Pre-Integration Information

Topic	Subject	Content
4.1.1	Happiness in Concentration	(1) *Pāmojja*, (2) *Pīti*, (3) *Passaddhi*, (4) *Sukha*, (5) *Samādhi*.
4.1.2	Practices of Happiness Access	(1) Mental Development (*dhammasamādhi*), (2) Wisdom Development.
4.1.4	Practices of GNH	(1) Sustainable and Equitable Social and Economic Development, (2) Environmental Conservation, (3) Cultural Preservation and Promotion, (4) Good Governance.
4.2.5	Means of Biofeedback Process	(1) Electromyography (EMG), (2) Electrodermograph (EDG), (3) Skin Temperature Thermography, (4) Blood Pulse Variability (BPV), (5) Heart Rate Variability (HRV), (6) Respiratory Sensors (RESP), (7) Electroencephalography (EEG).

Source: Asst. Prof. Dr. Sanu Mahatthanadull et al, 2020.

The knowledge that has shown in the above table will be used for subsequent integration.

4.3.2 Advantages and Restrictions Analysis of the Buddhist Principles on the Happiness Access and GNH

The analysis made here is for the advantages and restrictions of the Buddhist Principles on the Happiness Access and GNH.

a. Advantages Analysis

Firstly, the concept of happiness access according to Buddhist principle has an advantage in terms of Happiness has its own characteristics as according to the type that can be classified in many aspects. Including the explanations provided by the commentators were as clear as they can be. Secondly, the principle of Gross National Happiness

can best support Theravada concept of happiness in terms of social dimensions, is to focus on the development of social fundamentals. The goal is for the well-being of the population in the society.

b. Restrictions Analysis

Firstly, the restriction of Buddhist principle of happiness access is the lack of tangible indicators to measure happiness and the access to happiness. The reason for this is because the mental and wisdom development through the Buddhist meditation practice has its own distinctive characteristics. That is to say it can only be perceived by oneself, with abstract characteristics, and is self-enlightened within a practitioner. Still, this unique feature, at the same time, can be a restriction because those self-experiences cannot be measured by any equipment. It can be known only by the mind. Secondly, GNH cannot fulfill the self-access of happiness.

4.3.3 Advantages and Restrictions Analysis of the Biofeedback Theory

For the analysis of the biofeedback theory, it will be made both in terms of the advantages and restrictions.

a. Advantages Analysis of the Biofeedback Theory

One outstanding feature of biofeedback theory is it can be integrated harmoniously with Buddhist meditation. As in neurofeedback, it should be used as an aid to meditation while people perform their meditation and not as a replacement to meditation, and that while these devices may aid and assist those in their meditative practices, the goal of these practices themselves is ultimately the decrease of reliance on objects and constructs that provide support.[378] As Supriya Rai has discusses on the biofeedback breakthrough:

> Studying biofeedback from the point of Physiological and anatomical study, the body's endocrines system tells the ability of body in curing itself. Besides, some of the organs already have the

[378] Tracy Brandmeyer, Arnaud Delorme, "Meditation and Neurofeedback", **Frontiers in Psychology**, Vol. 4 Article 688 (October 2013): 1-3.

generative capacity. And the medical sciences will join hand. Therefore, new behavioral pattern can happen unlimited.[379]

A multidisciplinary study that integrates various sciences together cannot happen without religious dimension. Thus when the mental development according to the Buddhist dimension is applied to the psycho-physiological method of measurement, it could create a highly reliable Buddhist innovation as a result.

b. Restrictions Analysis of the Biofeedback Theory

There are two restrictions on the biofeedback theory, namely: - 1) Restriction in Practical Implementation, and 2) Restriction in Hi-cost.

1. Restriction in Practical Implementation

From the Western world point, Colleen H. Parker; Stanley Henry; and Louis W. C. Liu suggested that patients presenting with CC (Chronic constipation) with DD (dyssynergic defecation) had a lower symptom response rate compared with those with FI (fecal incontinence) when BFT (Biofeedback therapy) was limited to three sessions. Given that resources to provide BFT are limited[380] In terms of Eastern world Meditation, even though the created Model suggests the Bi-Dimensional development as ways for access to the happiness, but in fact, the 7 biofeedback means may be used only with happiness at the concentration level where mind and physical body mutually communicate each other within certain limitation. For other superior happiness within wisdom meditation practice (*paññā-bhāvanā*), it may require many more theories to explain as a multidisciplinary in the near future. More than that, we may need to study more deeply the relationship between the body, mind and human self-healing system. Supriya Rai suggests:

And the next step of bio-feedback is study how the physical body does healing itself that is related to the dimension of the mind. The

[379] Interview with Dr. Supriya Rai, Director, K. J. Somaiya Centre for Buddhist Studies, India, Jan 17, 2019.

[380] Colleen H. Parker, Stanley Henry, and Louis W. C. Liu, "Efficacy of Biofeedback Therapy in Clinical Practice for the Management of Chronic Constipation and Fecal Incontinence", **Journal of the Canadian Association of Gastroenterology**, Vol. XX No. XX (2018): 1-6.

physical human body has the capacity to heal but that can be only from deep practice.[381]

Thus this is a challenge to enhance the tool potential to measure advanced intellectual phenomena in the near future.

2. Restriction in Hi-cost

Biofeedback is a significant part in a treatment process. It deals in the context of cognitive, behavioral, and psychophysiological dimensions. Although evidence supports the efficacy of biofeedback for treating a number of disorders and for enhancing performance, significant barriers block both needed research and payer support for this method.[382]

Biofeedback may not be useful for disorders characterized by limited or low physiological responsivity, difficulties in recognizing physiological/affective states, or where physiological mechanisms are not centrally involved in the onset and perpetuation of symptoms (e.g. personality disorders).[383]

In conclusion, even though biofeedback can be integrated harmoniously with Buddhist meditation and can create a highly reliable Buddhist innovation but there are still some restrictions in terms of both implementation and cost. Thus the model of integrating this concept for happiness access should be carefully developed to be more effective and understandable way.

4.3.4 A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process

Before the discussion of the Model including its details, it is necessary to understand the users. The person who is able to utilize this Model is not limited just to the religious practitioners, or patients

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[381] Interview with Dr. Supriya Rai, Director, K. J. Somaiya Centre for Buddhist Studies, India, Jan 17, 2019.

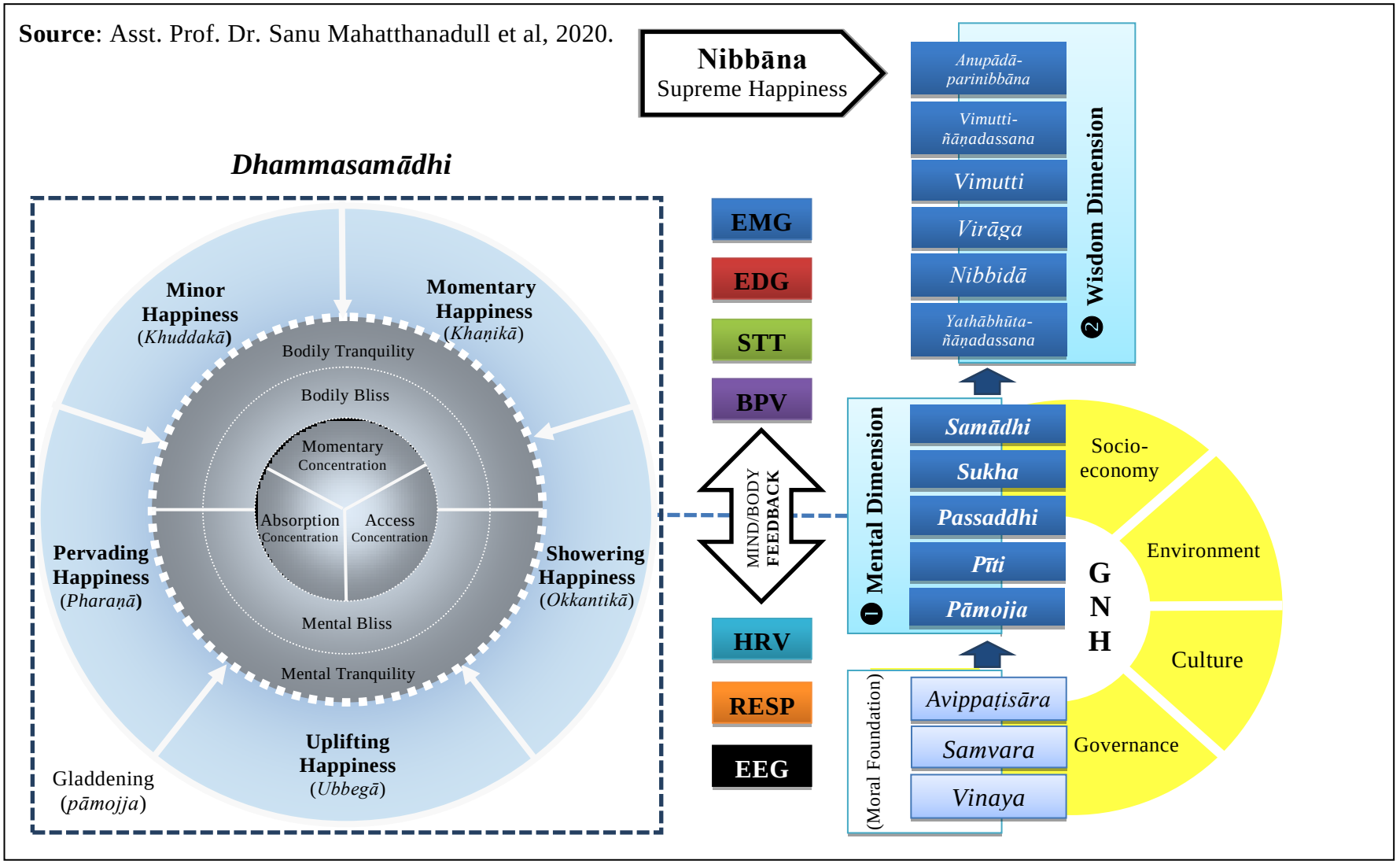
[382] Paul Lehrer, "Biofeedback: An Important but Often-Ignored Ingredient in Psychotherapy", **The Behavioral and Brain Sciences**, Vol. 4 No. 1 (2017): 57-63.

[383] Poppy L. A. Schoenberg, Anthony S. David, "Biofeedback for Psychiatric Disorders: A Systematic Review", **Appl Psychophysiol Biofeedback**, Vol. 39 (2014): 109-135.

receiving medical treatment using the biofeedback process only, but are general individuals regardless of genders, ages, and careers. That is the people who are eager to find happiness in their lives from every careers: scientists, engineers, architects, judges, lawyers, doctors, pharmacists, dentists, nurses, soldiers, polices, pilot, flight attendants, actors, actress, business men, carpenters, electricians, teachers, agriculturists, farmers, musicians, artists, or even prime ministers, etc. The reason for this is due to the equality of humankind. That is to say everyone has the right and freedom to access this happiness. It is a universal happiness, substantial *sukha* that exists in nature according to metaphysics, which requires Buddhist epistemology to seek, to access and maintain with the power of the individual's mental and wisdom development. Until the true accessible of highest happiness named "Nibbāna" is eventually substantialized to all human beings.

All previously discussed research findings that have been carefully selected to be integrated in order for presenting a model in this topic. In the following order the research team has proposed A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process. The details are as follows.

Figure 4.9: A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process



From the presented Model named "A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process", the column standing in the center of the model slightly towards to the right, demonstrates the 14 steps of attaining to the Nibbāna[384] the supreme happiness. They are defined by the 14 rectangle geometric shapes, starting from discipline (*vinaya*) at the bottom of the model, and ending with the complete extinction of craving (*anupādā-parinibbāna*) which is located at the top of the model. When one attains to this fourteenth stage, one enters into the final deliverance or Nibbāna. Each element is a factor to another element. For example, discipline (*vinaya*) is a factor for restraint (*saṃvara*), And restraint itself is a factor for non-remorse (*avippaṭisāra*), etc. This reasoning and consequence proceeded throughout the process up to the attainment of Nibbāna. In this particular 14 rectangle shapes, it is further divided into 3 main groups which has Bi-Dimensional Development included. They are: - (1) A Group at the Bottom, (2) A Group in the Middle, and (3) A Group at the Top, and (4) Bi-Dimensional Development, respectively.

a. First Group (at the Bottom): It is a group that comprises of 3 preliminary elements in which located at the bottom of the line framed by a rectangular window (marked with Moral Foundation), starting from the 1st position, for "discipline (*vinaya*); next the 2nd position, for "restraint" *(saṃvara)*; then to the 3rd position, for non-remorse (*avippaṭisāra*). This group has been organized as the first group at the base of the Model by representing the discipline. The implication of this substantial matter is about regulations and the orderliness of the physical body of human. Naturally human beings are born with innate raw instincts, which consist of 3 unwholesome rooted (*akusala-mūla*)[385] inside their mind, namely: - greed, hatred, and delusion. The interesting fact is that with the said instincts inherited, humans tend to express their thought (*mano-kamma*) through verbal (*vacī-kamma*) and bodily

[384] See Vin.V.164; Vism.13; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., p. 16.

[385] D.III.214, 275; A.I.201; 203; Vbh.106; Vism.454; Nd2.517; VbhA.382.

expressions (*kāya-kamma*)[386] in every possible ways that fulfills their basic instincts.

Buddhism therefore teaches human the principle of leanings, that is, the Threefold Training (*adhisīla-sikkha*, *adhicitta-sikkha*, and *adhipaññā-sikkha*)[387] which begins with knowing the basic instinct as a preliminary step. From this point, organizing one's own behaviors within the framework of good morals thus is crucial in terms of managing one's own behaviors. That is morality will determine desirable behaviors, not to trouble others who live in the same society.

When a practitioner clearly knows the true meaning of discipline, he or she will accept and observe to that discipline as a way of life. Thus discipline causes one's way of life to be full of restraint against all unwholesome and devils. And when he or she is safe from those unwholesome, the way of life is then without remorse and repentance but full of non-remorse finally. In short, discipline causes restraint; and restraint causes non-remorse.

Although discipline is of utmost importance as already mentioned. But this study focuses on providing in-depth body of knowledge about the "Bi-Dimensional development", whose essence lies in the analysis of the mental and wisdom development, as suggested in the model's name itself. However, this first group is important as "Moral Foundation", being a basis for the Bi-Dimensional development in the next higher level.

b. Second Group (in the Middle): It is a group consisting of 5 elements located in the middle of the line framed by a rectangular window (marked with ❶Mental Dimension), which starts from the 4th position, for "Gladdening" (*pāmojja*), to the 8th position, for "Concentration" (*samādhi*) are called "Concentration of the Dhamma" (*dhammasamādhi*). Among these, there are 5 types of happiness that a practitioner can emperically experience and access in the practice through mental development only. That is why these happiness are called

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[386] *Kamma-dvāra* can be literally translated as "the door of action", see J.IV.14; KvuA.135; DhsA.82.

[387] Vin.I.70; D.I.174; A.III.133; DhA.I.334; PvA.207.

"Happiness in concentration". They are: - (1) Gladdening (*pāmojja*), (2) Happiness (*pīti*), (3) Tranquility (*passaddhi*), (4) Bliss (*sukha*), and (5) Concentration (*samādhi*).

From this position, there is a dotted line connected to the *Dhammasamādhi*-description Diagram next to the far left of the model. The *Dhammasamādhi*-Diagram reflects the concept of Bhadantacariya Buddhaghosa that described as:

> Now, this fivefold happiness [*pīti*], when conceived and matured, perfects the twofold tranquility [*passaddhi*], that is, bodily and mental tranquility. When tranquility is conceived and matured, it perfects the twofold bliss [*sukha*], that is, bodily and mental bliss. When bliss is conceived and matured, it perfects the threefold concentration [*samādhi*], that is, momentary concentration (*khaṇika-samādhi)*, access concentration (*upacāra-samādhi*), and absorption concentration (*appanā-samādhi*).[388]

In addition to such factors, the Vinaya Pitaka stated: "*pāmujjaṃ pītatthāya pīti passaddhatthāya passaddhi sukhatthāya sukhaṃ samādhatthāya*"[389] in which they can be translated as "gladdening [*pāmojja*] is for the purpose of happiness [*pīti*], happiness is for the purpose of tranquility [*passaddhi*], tranquility is for the purpose of bliss [*sukha*], bliss is for the purpose of concentration [*samādhi*]. . .[390] From the above passages, it is noticeable that the 4 essential factors cause concentration. And when all of them have arisen, they are the 5 different kinds of state of happiness which a practitioner can expect to access. Phra Rajapariyatkavi (Somjin Wanjan) affirms "Concentration is a mental condition without worry and attachment but with lightness, comfort, peace of mind, and happiness."[391] Ven. Khenpo Karjung explains meditation, in fact, is the mind-body balancing activity:

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[388] Vism.144; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., p. 138.

[389] Vin.V.164.

[390] Vin.V.164; Vism.13; Op.cit.

[391] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

> While in the breathing meditation practice with mouth not opens too much, it balances the heat and energy of the body. While we just stretch our backbone, more consciousness just sends to the body. And in the same way it happens when we move our upper and little part of the body.[392]

The researcher agreed with the above explanation. Initially, the physical body began to enter the mode of posture adjustment. At this time the physical body may still be awake and unstable. The mind may be full of hindrances, e.g. restlessness (*uddhacca*) and anxiety (*kukkucca*) concerning for the external environment. Both mind and body will not communicate well as it should be at this stage. Only when the physical body has begun to adapt to the environment; and the mind began to build up confidence which causing good mind-body interaction, it will result in close and ultimate communication between the body and mind. Eventually the mind-body balance will arise together with the fivefold happiness in *Dhammasamādhi* in the end. They are what we are all seeking for in meditation experiences.

The essence of the *Dhammasamādhi*-Diagram is that it shows in details the abovementioned 5 elements, namely: - (1) the *pāmojja*, (2) the fivefold *pīti*[393], (3) the twofold *passaddhi*, (4) the twofold *sukha*, and (5) the threefold *samādhi*. Firstly, the former 4 elements depict the first four kinds of happiness being such causes for each other. Secondly, the latter

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[392] Interview with Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan, March 25, 2019.

[393] **The Fivefold Happiness (*pīti*) comprises of 5 kinds, namely:**

1. Minor Happiness (*Khuddakā-pīti*)**:** Minor happiness is only able to raise the hairs on the body.

2. Momentary Happiness (*Khaṇikā-pīti*): Momentary happiness is like flashes of lightning at different moments.

3. Showering Happiness (*Okkantikā-pīti*)**:** Showering happiness breaks over the body again and again like waves on the sea shore.

4. Uplifting Happiness (*Ubbegā-pīti*)**:** Uplifting happiness can be powerful enough to levitate the body and make it spring up into the air.

5. Pervading (rapturous) Happiness (*Pharaṇā-pīti*)**:** When pervading (rapturous) happiness arises, the whole body is completely pervaded, like a filled bladder, like a rock cavern invaded by a huge inundation.

- Vism.143-144; Bhadantacariya Buddhaghosa, **The Path of Purification (Visuddhimagga)**, Tr. By Bhikkhu Ñāṇamoli, 4th Ed., pp. 137-138.

element depicts the last kind of happiness that completes the access to the Fivefold Happiness in Concentration. They may be listed as follows:

The Fivefold Happiness in Concentration:

Pāmojja ➔ *Pīti* ➔ *Passaddhi* ➔ *Sukha* ➔ *Samādhi*

The column standing right at the center of the model represents the 7 major means[394] implemented in the biofeedback process are ordered from top to bottom. In each element will be replaced with abbreviations instead of the unique name of each tool, they are: - (1) Electromyography (EMG), (2) Electrodermograph (EDG), (3) Skin Temperature Thermography (STT), (4) Blood Pulse Variability (BPV), (5) Heart Rate Variability (HRV), (6) Respiratory Sensors (RESP), and (7) Electroencephalography (EEG), respectively. They are separated by a two-way arrow marked with text "MIND/BODY FEEDBACK" which indicates the measurement of the reactions between mind and body. All of these scientific indicators are highly accurate and reliable. They are widely accepted in terms of treatment, remedies, including medical therapies, etc. Thus there is no wonder that these 7 biofeedback means can be used harmoniously, as a skilfull means, in practicing Buddhist mental (*citta-bhāvanā*).[395] For the immediate benefit such as healthy and worldly happy and the ultimate benefit is Nirvana.[396] Phra Rajapariyatkavi (Somjin Wanjan) showed that it is highly possible to detect communication signals between the mind and the body using the nature of mind and body:

> In fact, tension does not directly affect the nervous system, but because of the signal transmission of the nervous system received from eyes, ears, nose, tongue, and body to the mind is done with unusual conditions, sometimes there is an error. The deliverance is

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[394] See C. Gilbert, D. Moss, "Biofeedback and Biological Monitoring", in D. Moss, A. McGrady, T.C. Davies, I. Wickramasekera (eds.), **Handbook of Mind-body Medicine for Primary Care: Behavioral and Psychological Tools**, (2003): 109-122; Timothy Culbert and Gerard A. Banez, "Pediatric Applications", in **Biofeedback: a Practitioner's Guide**, 4th ed. (2016): 643.

[395] D.III.219; M.I.237; S.IV.111; A.III.106; Nett.91.

[396] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

> not as good as it should be. As some teachers tried to explain the signaling cycle of perceptions and emotions in the human body; Those processes, if working without mental tension but with only unattached, the signal transmission will be smooth along the paths and then flow down along the nerves in the spinal cord. But if the mind is full of tense then it does not flow but will spin back into the brain and the brain will cause tension. Then it was left behind in the old mood. Persons then will repeatedly think or do when their thought can't be successfully transmitted. This is because the brain is the center of all knowledge. It is the last base before passing on knowledge to the mind.[397]

From the passage, the human brain is the starting point in the process of transmitting communication signals through various sensory organs that are used as a means of communication such as nerve, spinal cord, the six sensory organs are eyes, ears, nose, tongue, body and mind, etc. Messages that the brain transmits through such organs will travel along the path and end to the mind. "Mind can also reproduces or shows themselves in physical interactions. If mind or thinking is pure then actions are also pure"[398] Pahalawattage Don Premasiri states on such mind-body signaling communication:

> I believe there is a connection between thinking process and the certain chemical processes in the body. For instance, when fear arises there is a physiological process which changes the body. You start chilling and this may be associated with neuron processes as well as chemical processes. You sweat or shiver when you get scared of something.[399]

Therefore, when we are smart enough to use bio-feedback tools to measure these signals; the practitioners as mindful observers, are

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[397] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

[398] Interview with Prof. Dr. Geeta Manaktala, Panjab University, Chandigarh, India, Mar 25, 2019.

[399] Interview with Em. Prof. Dr. Pahalawattage Don Premasiri, University of Peradeniya, Sri Lanka, Jan 26, 2019.

encouraged to self-monitor at their own mind and body. When mind-body communication is interrupted, the signal will be detected and broadcast via Bio-feedback devices. And the practitioner will easily observe and is useful for self-learning. They will also be able to recognize the body's response to the mind under such circumstance. Phra Rajapariyatkavi (Somjin Wanjan) further states on the positive result:

> But on the other hand, if the signal that the person accepts comes with no stress or nonattached. It will be transmitted before the new signal is circulated as an input and output process. Any signal is caused by a stressful mental state with attached thinking, it would be a waste in the brain as a result.[400]

We may call such communication within the body as a bad communication full of stress, tention, attachment, which results from poor quality of mind. Whereas Phillip D. Stanley views that:

> When you are having a good emotion, it is also physiological effect, your blood pressure level goes up, the tension in your body goes up, including all chemicals that are associated with. But if you are angry, it is not good. In other words, it works in both way, good and bad. If you have a negative mental state, it has a significant physically imply.[401]

From all these discussions so far, happiness arises from concentration (samadhi); concentration arises from well communication between mind and body; well communication arises from the mental practice. All of this is based on the principle that "mind-body both affect each other in the two-way manner. Therefore, the essence is that practitioners naturally develop the ability of self-learning process by the observation skills of equiped monitor devices. This is to try to avoid of those negative results shown in the parameters. And on the contrary, in

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[400] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

[401] Interview with Prof. Dr. Phillip D. Stanley, Naropa University, Colorado, United States, Jan 13, 2019.

order to try to develop their mental quality even further until the results of the parameters shift to the positive domain.

But in terms of practicing wisdom meditation (*paññā-bhāvanā*),[402] it is still a challenge to enhance the tool potential to measure advanced intellectual phenomena in the near future.

Applying biofeedback scientific instruments to measure access to the Happiness is primarily based on a theory that "In the access of The Fivefold Happiness in Concentration, the physical body responds against such happiness through physiological signals at statistically significant difference". During the time that a practitioner is contemplating, with the biofeedback equipment appropriately selected, then various measurements could be accurately done throughout this Buddhist-Biofeedback integrated process. They are, for example, muscle tension, temperature, blood flow and pulse from the finger, heart rate, respiration, sweating response, posture alignment, and etc. Nevertheless, the only limitation of integrating biofeedback tools in order to measure the happiness access is that it may be used only with happiness at the concentration level. For other happiness with superiority may require many more theories to explain as a multidisciplinary in the near future.

In the bottom rightmost corner of the Model, is the space that conveys the concept of Gross National Happiness (GNH) of Vajrayāna School which is replaced by the geometric shape of a half circle. The boundary of this half circle covers 4 aspects of happiness,[403] which are the results of success based on the middle way concept with moderation and contentment.[404] They are: - (1) Sustainable and Equitable Social and Economic Development, (2) Environmental Conservation, (3) Cultural Preservation and Promotion, and (4) Good Governance. Such Gross National Happiness is important as "Social Happiness" where majority of population in the society has perfectly developed an "Individual

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[402] D.III.225, 285, 291; S.I.48; Dh.73, 301.

[403] RGoB, Bhutan National Human Development Report; Planning Commission, **Bhutan 2020: A Vision for Peace, Prosperity and Happiness, Part I-II**.

[404] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

Happiness" through the Bi-Dimensional development, both mind and wisdom. The GNH thus plays a crucial role as a mirror reflecting another aspect of human happiness through socio-economic, environmental, cultural, and governance aspects. Ven. Khenpo Karjung has described how to connect the dimension of life with social dimension "It's about the relaxation of mind and the body. Everything is about restless. Rest over life then the world can rest in peace."[405] Mental and physical relaxation can significantly transmit positive energy to society and the world as well.

Having viewed from this aspect, we will clearly notice the key connection between the two concepts of happiness, both Theravada and Vajrayāna Buddhism. That is, the scope of Vajrayāna's concept of social happiness according to the GNH covers the Theravada's concept of individual happiness, from 1st element called "*Vinaya*" to the 8th element called "*Samādhi*". The individual happiness and social happiness are as two sides of the same coin, in which they are closely related to each other and cannot be separated.

c. Third Group (at the Top): This is a group consisting of 6 elements located at the top of the line framed by a rectangular window (marked with ❷Wisdom Dimension), which starts from the 9th position, for "Correct knowledge and vision" (*yathābhūta-ñāṇadassana*), to the 14th position, for "Complete extinction of craving" (*anupādā-parinibbāna*) where Nibbāna can be attained. As the text in the flag, marked with "Nibbāna: Supreme Happiness", floating at the top position of the Model next to the left.

d. Bi-Dimensional Development: The Model suggests that there are only two dimensions of how a pratitioner can access to happiness. On one hand, the 1st dimension called **❶Mental Dimension** implies the happiness access through mental development as the accessing ways have been discussed. It is based on the principle that

[405] Interview with Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan, March 25, 2019.

"meditation can change the emotional structure of the person"[406] for the optimal mental development.

> Simply tranquil meditation (*samatha-kammaṭṭhāna*) in mental development such as contemplation of breathing (*ānāpānasati*) can give effect to human bio-feedback like a blood pressure, etc. We do not need those hours of sitting meditation but just ten minutes of tranquil meditation can creates great impact towards the physical responses. Sitting down for every few hours and what happens is when the stress is reduced. Then behaviors change and the person is feeling better.[407]

Ven. Khenpo Karjung suggests the key method to for the mental training:

> At that time one just relaxes the body and then stops talking. One does not have any works both bodily and verbally. And one does not need the work of the mind either. Let it be. No chasing. And when one stops chasing the mind, there is totally no works of bodily, verbally and mentally. Then one starts contemplate on the breathing.[408]

As being suggested, one effective way to develop one's mind is to know the nature of mind that always deceives the practitioners. That is to start by stopping all physical, verbal and mental activities. Then concentrate on the meditation object, for instance, the in and out breathings. Simply contemplating on our own breathing can be effective. Phillip D. Stanley views it helps elevate one's mental state "If you want to change your mental state, meditation will help. If you know nothing about the Buddhism, sit down and fall your breath, it will help you, it will calm you down."[409] Peter Harvey observed that "Most people are recently

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[406] Interview with Em. Prof. Dr. Pahalawattage Don Premasiri, University of Peradeniya, Sri Lanka, Jan 26, 2019.

[407] Interview with Dr. Supriya Rai, Director, K. J. Somaiya Centre for Buddhist Studies, India, Jan 17, 2019.

[408] Interview with Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan, March 25, 2019.

[409] Interview with Prof. Dr. Phillip D. Stanley, Naropa University, Colorado, United States, Jan 13, 2019.

quite good at reading the body language of somebody else but they are not necessarily so good in reading their own body language".[410] Therefore, as a wise Buddhist practitioner, one should develop own mind in order to protect oneself from oneself. That is to prevent one's own mind from deceiving oneself. He further explains:

> If one develops one's mind, the physical body feels different in better senses. One's state of mind confidently expresses the tone of voice. And sometimes when one is mindful of how one's body feels. It can tell what one's mind is like.[411]

The message he was suggesting indicates that the development of the human mind is actually the interaction between the body and mind that is communicated. That is, the physical body and morality play a role as the foundation (Moral foundation) for the higher mental and wisdom development (bi-dimensional development). Both the mind and body must be harmonized in order to create a balanced development. This is the way to practice according to the mental dimension.

On the other hand, the 2nd dimension called ❷**Wisdom Dimension** implies the happiness access through wisdom development. Phra Rajapariyatkavi (Somjin Wanjan) points out:

> Concentration (*samādhi*) and mindfulness are closely related. Because mindfulness (*sati*) and clear comprehension (*sampajañña*) supported each other. Wisdom is caused by mindfulness, whereas mindfulness is supported by concentration.[412]

Concentration, mindfulness, and wisdom are interdependent factors. The bi-dimensional development has a thin boundary line dividing the extent between concentration and wisdom.

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[410] Interview with Em. Prof. Dr. Peter Harvey, University of Sunderland, United Kingdom, Jan 13, 2019.

[411] Interview with Em. Prof. Dr. Peter Harvey, University of Sunderland, United Kingdom, Jan 13, 2019.

[412] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

In fact, the happiness access through the bi-dimensional development is inevitably based on the principle of holistic development that consists of four dimensions, namely: - (1) physical development, (2) moral development, (3) mental development, and (4) wisdom development. Peter Harvey has noted that:

> The physical development according to Buddhism, it does not mean the physical (*kāya*) fitness and healthy, but it mean the development of the ability to feel and recognize various mind-body conditions. Like the description in absorption (*jāna*) where you can feel happiness (*pīti*) and bliss (*sukha*) in the *kāya*.[413]

It is utterly interesting that this holistic development has the mind as a knower who empirically learns all mind-body phenomena that usually appears within the human bodies through the 6 sensory organs (*saḷayatana*), namely eyes, ears, nose, tongue, body and mind. Whereas all said components work in a multidimensional integration. It characterizes the corporeality and mentality (*rūpa-nāma*), the threefold training (*ti-sikkhā*), and the fourfold development (*bhāvita*). Thus it can be said that "bi-dimensional" is that all of the abovementioned components are combined by having "*citta-paññā*" at the center of development. As Ven. Dr. Khenpo Phuntsho Gyaltshen says:

> Mind [and wisdom] is over matter. If they are fully potential, then the physical fitness and moral completion will be automatically there. Mind [and wisdom] is at the center because mind [and wisdom] is in original form that will do moral and immoral actions. Immorality is totally not possible when you're with the good quality of the natural mind [and wisdom].[414]

It can be clearly seen that the dimension of human's mind and wisdom (*citta-paññā*) is an integrated vital part in augmenting human intelligence to the maximum extent, which is to intellectually understand

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[413] Interview with Em. Prof. Dr. Peter Harvey, University of Sunderland, United Kingdom, Jan 13, 2019.

[414] Interview with Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand, March 30, 2019.

the nature and the universal states of nature as they truly are. Phra Rajapariyatkavi (Somjin Wanjan) suggests:

> In practicing the Four Foundations of Mindfulness, first practitioner to do is consider the mind. When there is a distraction (*uddhacca*), he would have to draw his mind back by having mindfulness. Or may not draw the mind back, but have to mindfully know or aware of those ideas. This practice will make the mind to have a grip while being full of distractions. There are some relation between concentrate and mindfulness in supporting manner. Only when the practitioner really aims to move on to Nibbāna, the use of concentration alone is not enough. He must further use the wisdom to direct him to the Nibbāna.[415]

The above is a clever method of using concentration (*citta-bhāvanā*) and wisdom (*paññā-bhāvanā*) to benefit the practice of meditation in Buddhism. That is to say, we should optimize wisely both dimensions of mental and wisdom development for their ultimate benefit. Phillip D. Stanley supported the above statement by saying:

> It is not as beneficial as if you study the teachings through use of your wisdom (*paññā*). . . and if you study the Buddhist teachings on the five aggregates (*pañca-khanda*), selfishness, or studying ethics, how that come in consequences. When you are sitting in meditation and you observe the negative state of mind comes up, if you have inside awareness to them together with the threefold training are all elements of the Noble Eightfold Path, etc. These Dhamma teachings make meditation more beneficial.[416]

Therefore, the access to happiness through the human wisdom is the perpetual happiness that human beings worthy deserve. It is happiness at a level that is extremely discreet. In conclusion, the Bi-Dimensional Development demonstrates that although the mind and

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[415] Interview with Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of Mahachulalongkornrajavidyalaya University, Wang Noi, Ayutthaya, Thailand, Jan 17, 2019.

[416] Interview with Prof. Dr. Phillip D. Stanley, Naropa University, Colorado, United States, Jan 13, 2019.

wisdom are different in terms of dimensions but not different in their quintessence.

4.4 Concluding Remarks

Happiness in the Concentration implies various states of mind that appeared in the context of the concentration while the Thirteen Dyads of Happiness in the Sukha-vagga implies the thirteen different pairs of happiness (*sukha*). They are in line with the Buddhist practices, such as the *dhammasamādhi* that signifies the five kinds of virtues that make one to be firmness in the Dhamma; accessing through wisdom development, or access to happiness above happiness.

The way that GNH practice as the four pillars focusing on the middle path and contentment for individual and social happiness. While biofeedback has a strength character, that is its tools. Finally, when all of the knowledge is integrated together, the Model named “A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process” is the output.

Chapter V

Conclusion Discussion and Suggestions

The research entitled “A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process” consists of three objectives, namely: - (1) to explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH), (2) to examine the theory of biofeedback, and (3) to propose a conceptual model of bi-dimensional development for happiness access by biofeedback process. This is a qualitative research work. The methodology of the research has been established employing the research materials and instruments, such as the collection and analysis of data from primary and secondary sources, in-depth interviews and the use of technological devices, etc. The abovementioned question forms for in-depth interviews with the Item-Objective Congruence (IOC) were examined by 3 experts. The sample population that appeared in this research concerns with groups of 8 key-informants who are monks and Buddhist scholarly representatives with knowledge of Buddhism and sciences. They are expertise in interdisciplinary integration into education and way of life sciences. There are totally 6 countries among the regional and international organizations around the world. Therefore, the researcher presents the three topics, namely: - (1) Conclusion, (2) Discussion, and (3) Suggestions.

5.1 Conclusion

There are three conclusions, in line with the objectives, to be presented, namely: - (1) Concept of Happiness Access according to Buddhist Principles and the Concept of Gross National Happiness (GNH), (2) Theory of Biofeedback, and (3) A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process.

5.1.1 Concept of Happiness Access according to Buddhist Principles and the Concept of Gross National Happiness (GNH)

The Concept of Happiness Access according to Buddhist Principles and the Concept of Gross National Happiness (GNH) are as follows:

Definitions and Types of Happiness according to Buddhist Principle: Firstly, Definitions of Happiness according to Buddhist Principle started by studying the vital term "happiness" is an English word is literally translated from multiple Pali terms, such as, *iṭṭha*, *nibbuti*, *pasīdana*, *pāmujja*, *pāmojja*, *pīti*, *bhagga*, *vaḍḍhi*, *vitti*, *sampatti*, *sampadā*, *sampasādana*, *sātatā*, *siva*, *sukha*, *sugati*, *suhatā*, *seyya*, *sokhya*, *somanassa*. Especially the term "*sukha*" refers to the idea of happiness of the world. When it accompanies with physical body, it is called bodily happiness. And when it accompanies with mind, it is called mental happiness. Happiness (*sukha*) has suffering (*dukkha*) as the opposite state. While "*pīti*" implies happy-mindedness in the context of the fivefold absorption, is a pleasure of happiness [in the first and second absorption] or *pītisukha*. Nevertheless in this research, the happiness that is mentioned here will be a specific context of happiness in the dimension of the mental and wisdom development, for example, *pāmojja*, *pīti*, *sukha*, etc.

Secondly, Types of Happiness according to Buddhist Principle refers to two main types of happiness. They are: - 1) Happiness in the Concentration, and 2) The Thirteen Dyads of Happiness in the Sukha-vagga. 1) Happiness in the Concentration implies various states of mind that appeared in the context of the concentration consisting of four categories, namely: - (1) Concentration (*Samādhi*), (2) Bliss (*Sukha*), (3) Gladdening (*Pāmojja*) and Tranquility (*Passaddhi*), and (4) Happiness (*Pīti*). They represent the five kinds of state of happiness, namely: - *pāmojja*, *pīti*, *passaddhi*, *sukha*, and *samādhi*.

Having happy habit *(sukha-sīla)* as a fundamental level of happiness, the said particular happiness can be achieved gradually. They reflect good qualities of mind when it is properly trained by the four absorptions of the right concentration (*sammā-samādhi*). And eventually it

will lead to the *Nibbāna*, the summit of human's liberation or the greatest happiness of mankind.

While the Thirteen Dyads of Happiness in the Sukha-vagga implies the thirteen different pairs of happiness (*sukha*), consisting of Pleasure of home (*gihi-sukha*), and pleasure of home-leaving (*pabbajjā-sukha*), for instance. Among such those, there are the higher happiness that are more profound and pre-eminance. They are called "The Thirteen Superior *Sukhas*" consisting of: - (1) Home-leaving (*pabbajjā-sukha*), (2) Renunciation (*nekkhamma-sukha*), (3) Not clinging to rebirth (*nirupadhi-sukha*), (4) Attends freedom from the *āsavas* (*ānāsava-sukha*), (5) Non-carnal (*nirāmisa-sukha*), (6) Ariyan (*ariya-sukha*), (7) Mental (*cetasika-sukha*), (8) Without zest (*nippīti-sukha*), (9) Indifference (*epekkhā-sukha*), (10) Musing concentration (*samādhi-sukha*), (11) Object of meditation which does not arouses zest (*nippītikārammaṇañ-sukha*), (12) Object that causes indifference (*upekkhārammaṇañ-sukha*), and (13) Formless for object of meditation (*arūpārammaṇañ-sukha*). Therefore the practitioners should wisely choose to access these said *sukhas*.

Practices of Happiness Access according to Buddhist Principle: First, the concentration of the Dhamma signifies the five kinds of virtues that make one to be firmness in the Dhamma. They are Gladdening (*pāmojja*), Happiness (*pīti*), Tranquility (*passaddhi*), Bliss (*sukha*), and Concentration (*samādhi*). It gives three different implications, firstly to (1) the ten wholesome courses of action, secondly to (2) the four sublime states of mind. These implications give rise to the concentration of mind as the four paths (*maggas*) and the one-pointedness of consciousness (*citta-ekaggatā*). Lastly, to (3) concentrative meditations where it leads to the total destruction of the corruptions (*āsavānam khaya*) is Nibbāna.

Second, happiness access through wisdom development based on the principles of holistic development of human beings that consists of four dimensions, namely: physical development, moral development, mental development, and intellectual development. It can be clearly seen that the dimension of human's wisdom is an integrated vital part in augmenting human intelligence to the maximum extent, which is to

intellectually understand the nature and the universal states of nature as they truly are. Therefore, the access to happiness through the human's wisdom is the perpetual happiness that human beings worthy deserve. It is happiness at a level that is extremely discreet. In other words, it is the happiness that comes from living according to the Buddhist middle path.

Third, "Access to Happiness above Happiness" implies the four steps to deal with the *dukkha-sukha* dichotomy of dualism. The Buddhist practice based on this way is just to conform to the Devadaha sutta. It is a guideline for managing both suffering (*dukkha*) and happiness (*sukha*) just in order to deal with them using the four wise steps: 1) The ability to live with existing sufferings, 2) The pursuit of righteous happiness, 3) detachment to the happiness acquired, and finally 4) Total elimination of suffering. A practitioner who follows these steps can ultimately eradicate all sufferings and access to perpetual happiness. That is one should avoid all wrong ways of practice but always try to practice in accordance with the Buddhist right mental disposition (*sammā-paṭipaṭṭi*) in which it also requires one's right view (*sammā-diṭṭhi*) either. And this shows that the right striving always result in the accessible of the happiness above happiness, that is, higher and highest kind of happiness, until one gets to the Nibbāna eventually.

Origin and development of GNH: Gross National Happiness (GNH) was articulated by His Majesty to indicate that development has many more dimensions than those associated with Gross Domestic Product. It is grounded as the basic concept that happiness is a universal aspiration and should be located at the core of development. In 2008, the Constitution of Bhutan instituted the GNH as the goal of the government of Bhutan to develop the country. Nowadays, Bhutan is still known to the world community as Gross National Happiness as the country that founded this concept. It is the first country and has been continuously developed to the present day.

Practices of GNH: The practices of Gross National Happiness are officially constructed under the four pillars are described in the following way, namely: - 1) Sustainable and Equitable Social and Economic Development, 2) Environmental Conservation, 3) Cultural

Preservation and Promotion, and 4) Good Governance. The teachings about living along the middle path including living with contentment are also emphasized in the practice of GNH.

5.1.2 Theory of Biofeedback

Theory of Biofeedback may be concluded as follows.

Historical Perspective of Biofeedback: The theory of biofeedback preliminary originated during the mid-20th century in 1961, under the claimed that the human's autonomic processes were surprisingly controllable. Later on, the said theory has been continuously developed until the present time which is an era in which technological progress has been evolutionary fulfilled to the maximum capacity.

Meaning of Biofeedback: Biofeedback refers to a therapeutic procedures or a patient-guided treatment in the Applied Psychophysiology that employs a physiological responses process technique whereby a subject's mind is trained to gain some element of voluntary control over certain bodily functions that are normally unconsciously regulated by the autonomic nervous system (ANS). It is a closed feedback loop mechanism or a servo system which controls a biological process where the hypothalamus is alerted to abnormal biochemical levels. The essence is to use instruments that make the body's signals decodable to the mind. The biological signals that are fed back to the subject in order for the subject to develop techniques of manipulating them.

Ends of Biofeedback Process: The Ends of Biofeedback Process thus signify six different dimensions, namely:- (1) to entrain successive changes in performance and ability to self-regulate, (2) to increase awareness of self in relation to the world, (3) to reduce the stress levels for relaxation, (4) to cure the diseases, (5) to improve the levels of physical performance, and (6) to obtain contemplation and wisdom.

Ways of Biofeedback Process: The Ways of Biofeedback Process represent the two different methods, namely: - (1) Psycho-physiological Training Method, and (2) Meditation Relaxation.

Means of Biofeedback Process: The Means of Biofeedback Process deal with the skillful means concept of using the seven highly effective measuring instruments, namely: - (1) Electromyography (EMG), (2) Electrodermograph (EDG), (3) Skin Temperature Thermography, (4) Blood Pulse Variability (BPV), (5) Heart Rate Variability (HRV), (6) Respiratory Sensors (RESP), and (7) Electroencephalography (EEG). When they are integrated with the Buddhist meditation, particularly to the concentration, a practitioner can entrain the assessment of happiness in a tangible way.

5.1.3 A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process

Pre-Integration Information: The detailed information collected in this research is divided into two sets. They are the ground information and the particular information that is used for integration in order to create the Conceptual Model. The latter information is therefore called "pre-integration information" which consists of (1) Happiness in the Concentration, (2) Practices of Happiness Access, (3) Practices of GNH, and (4) Means of Biofeedback Process.

Advantage and Restriction Analysis of the Buddhist Principles on the Happiness Access and GNH: The concept of happiness access according to Buddhist principle has an advantage in terms of Happiness has its own characteristics as according to the type that can be classified in many aspects. Including the explanations provided by the commentators were as clear as they can be. While the principle of Gross National Happiness can best support Theravada concept of happiness in terms of social dimensions, is to focus on the development of social fundamentals. The goal is for the well-being of the population in the society.

The restriction of Buddhist principle of happiness access is the lack of tangible indicators to measure happiness and the access to happiness. The reason for this is because the mental and wisdom development through the Buddhist meditation practice has its own distinctive characteristics. That is to say it can only be perceived by oneself, with abstract characteristics, and is self-enlightened within a practitioner. Still, this unique feature, at the same time, can be a restriction

because those self-experiences cannot be measured by any equipment. It can be known only by the mind. While GNH focuses more of the social dimension of happiness.

Advantage and Restriction Analysis of the Biofeedback Theory: Biofeedback theory can benefit to Buddhism in terms of "perfect combination" between biofeedback scientific method and Buddhist religion. That is when the mental development according to the Buddhist dimension is applied to the psycho-physiological method of measurement; it could create a highly reliable Buddhist innovation as a result. Even so, there are two restrictions on the biofeedback theory, namely: - (1) Restriction in Practical Implementation, and (2) Restriction in Hi-cost.

A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process: The created Model suggests that there are only two dimensions of how a pratitioner can access to happiness. On one hand, the 1st dimension called ❶**Mental Dimension** implies the happiness access through mental development as the accessing ways have been discussed. What interesting is the 7 biofeedback means can be used harmoniously in the practice of Buddhist mental (*citta-bhāvanā*) in concentration training.

On the other hand, the 2nd dimension called ❷**Wisdom Dimension** implies the happiness access through wisdom development is an integrated vital part in augmenting human intelligence to the maximum extent, which is to intellectually understand the nature and the universal states of nature as they truly are. Therefore, the access to happiness through the human wisdom is the perpetual happiness that human beings worthy deserve. It is happiness at a level that is extremely discreet, that is Nibbāna, the supreme happiness.

5.2 Discussion

All new knowledge presented in this research reflects the developing process of knowledge in the modern world. Although, Buddhism has been expounded the series of knowledge on happiness and its access in detail among different enormous scriptures as, detailed by the research team. In addition, the other side of the knowledge obtained from the study of Western wisdom based on biofeedback theory is deeply

detailed. It is also reliable because it consists of deep data and accurate and reliable measuring tools. Therefore, when the two sciences are integrated together, it occurs “New knowledge” that is unique and quite new in academic surroundings.

Although nowadays, multiple researchers have presented the Buddhist principle of holistic life development. As they are available can be accessed not so difficult. Nevetheles, the body of knowledge “Bi-Dimensional Development” uniquely proposed in this study is truly brand new in which it has never been presented anywhere before. The creation of this Bi-Dimensional Development Theory is based on the basic principle that “The abstract *citta-paññā* is essential as a knower towards the happiness”. Because happiness is not a form but abstract. Human’s mind and wisdom is also abstract. Therefore, happiness is a state that requires only mental and intellectual access. Thus the Model presented in this research is particularly based on this key principle.

5.3 Suggestions

There are suggestions given from the research group in three fields, namely: - (1) Policy Suggestions, (2) Operational Suggestions, and (3) Suggestions for Further Research.

5.3.1 Policy Suggestions

1. Hospitals and public health organizations that focus on studying and learning Biofeedback process in their treatments should urge members within organization in order to practice the *citta-paññā* developing process by integrating with the biofeedback scientific tools for the whole new standard of curing the patients.

2. Government sectors, state-enterprises, and private sectors should develop the series of knowledge as well as Buddhist mental and wisdom training activities, and publicize the body of knowledge to the people to the most widespread.

5.3.2 Operational Suggestions

1. Practitioners of Buddhist monks, laity, academics and general interests should aware of knowledge in understanding and practice especially through the *citta-paññā* developing process in order to be able

to access to the fivefold happiness in *Dhammasamādhi* using the biofeedback scientific tools.

2. Mahachulalongkornrajavidyalaya University, Buddhist Research Institute of MCU, educational institutes, and related Units should utilize the research's finding for general Buddhist teaching activities particularly the course of Seminar on Buddhism and Modern Sciences.

3. Meditation centers both domestic and international should utilize the "Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process" to their daily routine practice. However, the biofeedback process may be implemented together for the maximum result.

5.3.3 Suggestions for Further Research

In conducting this research, according to the objectives established including the scope of the research, there are some restrictions on the operation. However, the researcher team offers suggestions for further research as follows:

1. Biofeedback Training Course for Memory Improvement: A Case Study of International Buddhist Studies College (IBSC) of Mahachulalongkornrajavidyalaya University;

2. Mindfulness Learning: An Integrated Method between Buddhist Mindfulness and Biofeedback Process to Enhance the Learning Efficiency of the International Students in Thailand;

3. Bliss (*sukha*) Access: An Integrated Method between Buddhist Concentration and Biofeedback Training Program to Enhance the Meditation Progress of the Practitioners"

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APENDIX I

Research Article

A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process

Abstract

This paper presents the qualitative research consisting of three objectives, namely: - (1) to explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH); (2) to examine the theory of biofeedback; and (3) to propose a conceptual model of bi-dimensional development for happiness access by biofeedback process. The data collections and in-depth interviews were carried out with 8 key-informants who are monks and Buddhist scholarly representatives with knowledge of Buddhism and sciences from 6 countries with the Item-Objective Congruence (IOC) examined by 3 experts.

The findings shown that Buddhism suggests "Access to Happiness above Happiness", that is access to superior happiness by dealing with the *dukkha-sukha* dichotomy of dualism; while the practice of GNH constructed by the four pillars based on the middle path and contentment that deals with social engagement. The Biofeedback Process, using EEG the instruments for instance, when integrated with the Buddhist meditation, a practitioner can entrain the assessment of happiness in a tangible way. As for the Model created, it suggests the bi-dimensional development for happiness access. Firstly, the MENTAL Dimension implies the development of mind in order to access to the fivefold happiness in concentration, namely: - (1) Gladdening (*pāmojja*), (2) Happiness (*pīti*), (3) Tranquility (*passaddhi*), (4) Bliss (*sukha*), and (5) Concentration (*samādhi*). The 7 biofeedback means can be used harmoniously in the practice of Buddhist mental (*citta-bhāvanā*) training where such those happiness can be measured from the mind-body phenomena. Secondly, the WISDOM Dimension implies development of wisdom for perpetual happiness access, that is, Nibbāna, the supreme happiness.

Keywords: Biofeedback Process, Bi-Dimensional Development, Conceptual Model, Happiness Access.

Introduction

Buddhism has mentioned the principle of holistic life development is the mechanism for the development of the physical body, behavior, mind and human intelligence. They are the 4 aspects of life-developers which cover the whole body of life's physical, moral, mental, and wisdom well-being. These 4 areas are a necessary mechanism to drive human self-development ability for both physical and mental happiness. In a smaller scale, the happiness of individuals is only limited within themselves. But in a larger scale, such happiness will extend to the society where every social member makes a quality co-existence. While the Gross National Happiness (GNH) is not only a national multidimensional development model for Bhutan but also a defining component of the image of the Bhutanese state itself, portraying an autonomous and coherent entity leading the pursuit of national happiness in partnership with Bhutanese society (Schroeder, 2018). Such society depicts a place where the stream of happiness among the coexistence of every social member flows constantly and uninterruptedly.

On the contrary, biofeedback is a process that enables an individual to learn how to change physiological activity for the purposes of improving health or performance. Precise instruments measure physiological activity such as brainwaves, heart function, breathing, muscle activity, and skin temperature. These instruments rapidly and accurately "feed-back" information to the user. The presentation of this information, often in conjunction with changes in thinking, emotions, and behavior, may support desired physiological changes. Over time, these changes can endure without continued use of an instrument (Dvorznak, 1997). Due to the fact that human beings are capable of developing their mind and wisdom which is closely related to the innate physical body, it therefore shows us the significant relationship between corporeality and mentality. Therefore, if we can apply the aforementioned bio-feedback tools in the meditation practice, we should be able to make the said relationship be processed into numerical data for practitioners to check their meditative awareness effectively.

The research team thus suggests that the research topic “A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process” is an in-depth study of the concept of bi-dimensional human development mechanisms in Buddhism. This is an urgent need to study the said matter in order to deepen our understanding towards the underlined concept of biofeedback process, the bi-dimensional development and the happiness access. They can be considered as helping state to prevent and solve public health problems that are urgent. Besides, it is a sustainable strengthening of the public health for the country’s population. And finally it can be able to access to the happiness, the true need of mankind.

Objectives of the Research

1 To explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH).

2 To examine the theory of biofeedback.

3 To propose a conceptual model of bi-dimensional development for happiness access by biofeedback process.

Research Methodology

This is a qualitative research. There are six stages in the research process conducted altogether respectively as follows:

1. Outline Construction / Problem Discussion: Outlining construction which signifies constructing the overall outline of the work in all related dimensions corresponding to the objectives. Then the problem discussion, among the research team led by the research adviser, is made by discussing the problems encountered according to the significance of the studies.

2. Data Collection: Starting by collecting data from the primary source and the secondary sources among Pāli, Thai and English languages.

3. In-depth interviews and development of Body of Knowledge: The in-depth interviews were carried out with 8 key-informants from 6 countries among the regional and international organizations around the

world who are monks and Buddhist scholarly representatives with knowledge of Buddhism and sciences with the interview forms IOC were examined by 3 experts: - (1) Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of MCU, Thailand; (2) Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan; (3) Ven. Dr. Khenpo Phuntsho Gyaltshen, Director of Mahapanya Vidayalai (MPV), Songkhla Province, Thailand; (4) Em. Prof. Dr. Peter Harvey, University of Sunderland, United Kingdom; (5) Prof. Dr. Phillip D. Stanley, Naropa University, Colorado, United States; and (6) Em. Prof. Dr. Pahalawattage Don Premasiri, University of Peradeniya, Sri Lanka; (7) Prof. Dr. Geeta Manaktala, Panjab University, Chandigarh, India; (8) Dr. Supriya Rai, Director, K. J. Somaiya Centre for Buddhist Studies, India.

4. Creation of Ground Knowledge: Ground knowledge relating to Buddhist happiness and biofeedback was created at this step.

5. Analysis, Synthesis, Interpretation, and Integration: They will be carried out carefully by using the ground level-knowledge obtained in the previous step.

6. Finalizing a Completed Version of the Research Report: Starting by identifying significant research findings; compilation of bodies of knowledge and insights. Then it is formulating conclusions, conducting discussions, as well as suggesting useful information for possible further researches.

Research Findings

1. Buddhist Perspective: happiness is an English word can be literally translated from multiple Pali terms, such as, *iṭṭha*, *nibbuti*, *pasīdana*, *pāmujja*, *pāmojja*, *pīti*, *bhagga*, *vaḍḍhi*, *vitti*, *sampatti*, *sampadā*, *sampasādana*, *sātatā*, *siva*, *sukha*, *sugati*, *suhatā*, *seyya*, *sokhya*, *somanassa*. Especially the term "*sukha*" refers to the idea of happiness of the world. When it accompanies with physical body, it is called bodily happiness. And when it accompanies with mind, it is called mental happiness. Happiness (*sukha*) has suffering (*dukkha*) as the opposite state. While "*pīti*" implies happy-mindedness in the context of the fivefold absorption, is a pleasure of happiness [in the first and second

absorption] or *pītisukha*. Nevertheless in this research, the happiness that is mentioned here will be a specific context of happiness in the dimension of the mental and wisdom development, for example, *pāmojja*, *pīti*, *sukha*, etc.

In Buddhism, happiness has been classified in a multidimensional and comprehensive way from home happiness (*gihi-sukha*) to happiness in concentration (*samādhi-sukha*), then eventually to the happiness of the noble people (*ariya-sukha*). They are exhibited in the following table named "The Thirteen Dyads of *sukha* based on Sukha-vagga" (A.I.80), Woodward, 1979).

Table 1: The Thirteen Dyads of *sukha* based on Sukha-vagga

Dyad	Pleasure (*sukha*)			
1.	×	Home (*gihi-sukha*)	✓	Home-leaving (*pabbajjā-sukha*)
2.	×	Sensuality (*kāma-sukha*)	✓	Renunciation (*nekkhamma-sukha*)
3.	×	Clinging to rebirth (*upadhi-sukha*)	✓	Not clinging to rebirth (*nirupadhi-sukha*)
4.	×	Attends the *āsavas* (*āsava-sukha*)	✓	Attends freedom from the *āsavas* (*ānāsava-sukha*)
5.	×	Carnal (*sāmisa-sukha*)	✓	Non-carnal (*nirāmisa-sukha*)
6.	✓	Ariyan (*ariya-sukha*)	×	Non-Ariyan (*anariya-sukha*)
7.	×	Bodily (*kāyika-sukha*)	✓	Mental (*cetasika-sukha*)
8.	×	With zest (*pīti-sukha*)	✓	Without zest (*nippīti-sukha*)
9.	×	Delight (*sāta-sukha*)	✓	Indifference (*epekkhā-sukha*)
10.	✓	Musing concentration (*samādhi-sukha*)	×	Without musing concentration (*asamādhi-sukha*)
11.	×	Object of meditation which arouses zest (*sappītikārammaṇañ-sukha*)	✓	Object of meditation which does not arouses zest (*nippītikārammaṇañ-sukha*)
12.	×	Object which causes delight (*sātārammaṇañ-sukha*)	✓	Object that causes indifference (*upekkhārammaṇañ-sukh*a)
13.	×	Visible object for meditation (*rūpārammaṇañ-sukha*)	✓	Formless for object of meditation (*arūpārammaṇañ-sukha*)

Note: The symbol ✓ represents the superior pleasure, while the symbol × marks the inferior pleasure.

The above table is divided into two columns. The left-side column shows each type of happiness. While the right-side column shows happiness in contrast to the left side. For example, Home-leaving happiness is in contrast to Home happiness. As for the rows, they represent the thirteen different classifications of happiness, from Home-happiness to Visible-object-for-meditation happiness. Lastly, the check signs (✓) represent the pleasure that are superior, while the cross signs (×) mark the pleasure that are inferior.

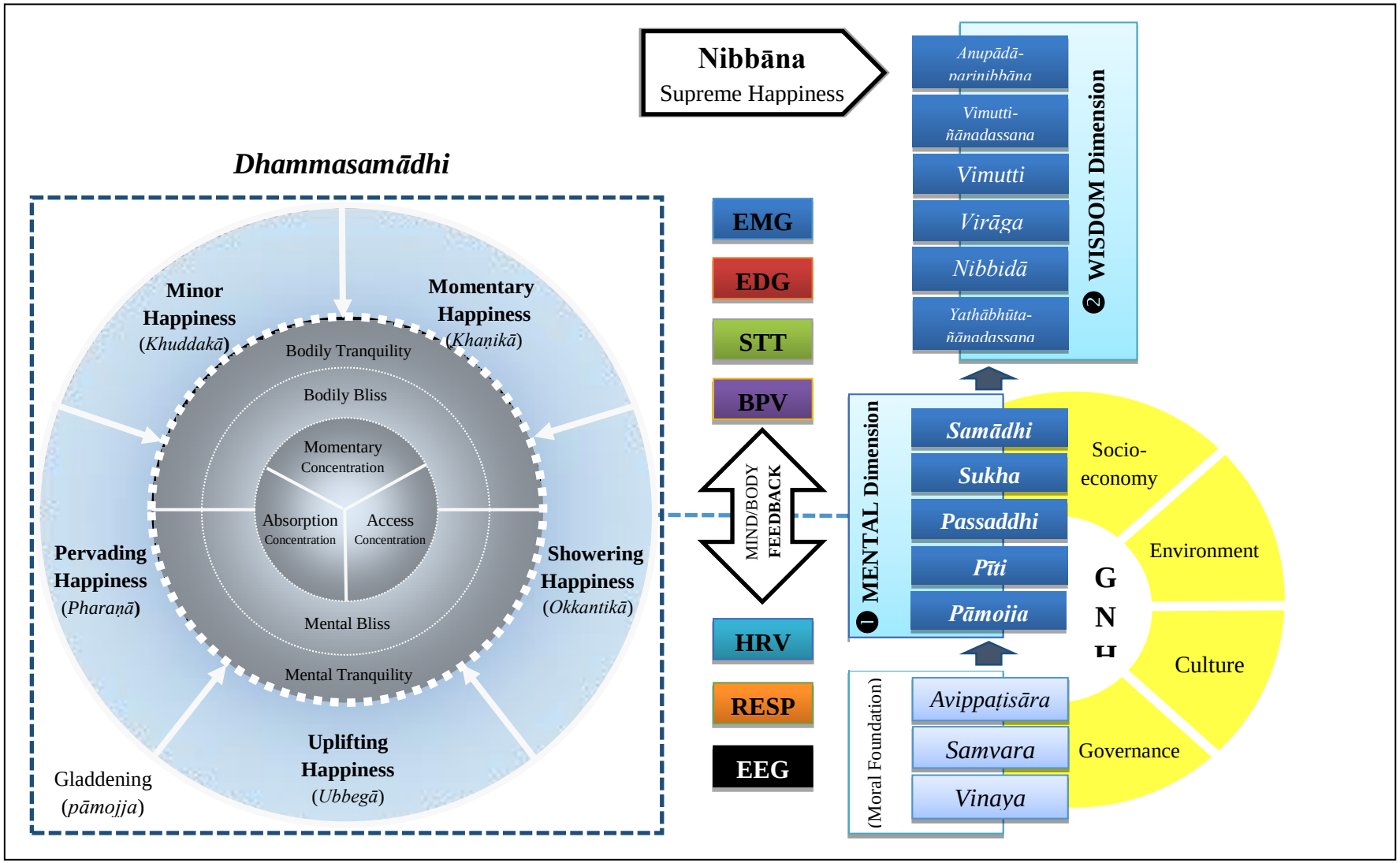
GNH Perspective: Apart from such Theravāda Buddhist principles, the practices of Gross National Happiness are officially constructed under the four pillars (RGoB, 2005), Planning Commission, 1999) are described in the following way, namely: - 1) Sustainable and Equitable Social and Economic Development, 2) Environmental Conservation, 3) Cultural Preservation and Promotion, and 4) Good Governance. The four pillars of GNH and their nine domains act as a strategic framework that is rooted in Buddhist values. It guides the achievement of happiness as the end of development. A bridge over the both Buddhist sects alternatively leads to the same destination is happiness. The only difference is that GNH in Vajrayana Buddhism focuses on the social happiness context. Besides, the GNH is judiciously used to strengthen social dimension of humankind.

2. Biofeedback implies to a therapeutic procedures or a patient-guided treatment in the Applied Psychophysiology that employs a physiological responses process technique whereby a subject's mind is trained to gain some element of voluntary control over certain bodily functions that are normally unconsciously regulated by the autonomic nervous system (ANS). Therefore the means of biofeedback that are usually founded available nowadays, may be classified into 7 types depending on psychophysically and biomechanically, they are 1) Electromyography (EMG), 2) Electrodermograph (EDG), 3) Skin Temperature Thermography, 4) Blood Pulse Variability (BPV), 5) Heart Rate Variability (HRV), 6) Respiratory Sensors (RESP), and 7) Electroencephalography (EEG). Biofeedback thus plays roles as a tool to help practitioners realize their happiness; and in processing the

relationships between meditation progress and physiological responses in meditation phenomena.

3. Eventually, the research team has finally proposed A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process. The details are as follows.

Figure 1: A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process



From the presented Model named “A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process”, It may be preliminary stated that “happiness access” defines both the individual happiness in concentration (*samādhisukkha*) and the social happiness as in the GNH’s Socio-economic and environmental happiness for instance.

The column standing in the center of the model slightly towards to the right, demonstrates the 14 steps of attaining to the Nibbāna (Vin.V.164), Vism.13), Bhadantacariya Buddhaghosa, 2010) the supreme happiness. They are defined by the 14 rectangle geometric shapes, starting from discipline (*vinaya*) at the bottom of the model, and ending with the complete extinction of craving (*anupādā-parinibbāna*) which is located at the top of the model. When one attains to this fourteenth stage, one enters into the final deliverance or Nibbāna. Each element is a factor to another element. For example, discipline (*vinaya*) is a factor for restraint (*saṃvara*), And restraint itself is a factor for non-remorse (*avippaṭisāra*), etc. This reasoning and consequence proceeded throughout the process up to the attainment of Nibbāna. In this particular 14 rectangle shapes, it is further divided into 3 main groups: - (1) A Group at the Bottom, (2) A Group in the Middle, and (3) A Group at the Top.

Whereas in the bottom rightmost corner of the Model, is the space that conveys the concept of Gross National Happiness (GNH) of Vajrayāna School which is replaced by the geometric shape of a half circle. The boundary of this half circle covers 4 aspects of happiness, (RGoB, 2005) which are the results of success that comes from: - (1) Sustainable and Equitable Social and Economic Development, (2) Environmental Conservation, (3) Cultural Preservation and Promotion, and (4) Good Governance. Such Gross National Happiness is important as “Social Happiness” where majority of population in the society has perfectly developed an “Individual Happiness” through the bi-dimensional development, both mind and wisdom. The GNH thus plays a crucial role as a mirror reflecting another aspect of human happiness

through socio-economic, environmental, cultural, and governance aspects.

In addition, the column standing at the center of the model represents the 7 major means (Gilbert, 2003), Culbert, 2016) implemented in the biofeedback process are ordered from top to bottom. In each element will be replaced with abbreviations instead of the unique name of each tool, they are: - (1) Electromyography (EMG), (2) Electrodermograph (EDG), (3) Skin Temperature Thermography (STT), (4) Blood Pulse Variability (BPV), (5) Heart Rate Variability (HRV), (6) Respiratory Sensors (RESP), and (7) Electroencephalography (EEG), respectively. They are separated by a two-way arrow marked with text "MIND/BODY FEEDBACK" which indicates the measurement of the reactions between mind and body. All of these scientific indicators are highly accurate and reliable. They are widely accepted in terms of treatment, remedies, including medical therapies, etc. Thus there is no wonder that these 7 biofeedback means can be used harmoniously, as a skilfull means, in practicing Buddhist mental (*citta-bhāvanā*). (D.III.219), M.I.237), S.IV.111), A.III.106), Nett.91) But in terms of practicing wisdom meditation (*paññā-bhāvanā*), (D.III.225, 285, 291), S.I.48), Dh.73, 301) it is still a challenge to enhance the tool potential to measure advanced intellectual phenomena in the near future.

The Model suggests that there are only two dimensions of how a pratitioner can access to happiness. On one hand, the 1st dimension called ❶**MENTAL Dimension** implies the access to the fivefold happiness in concentration (*Dhammasamādhi*), namely: - (1) *pāmojja*, *pīti*, *passaddhi*, *sukha*, and *samādhi* through mental development described in the figure on the left. On the other hand, the 2nd dimension called ❷**WISDOM Dimension**, from "*yathābhūta-ñāṇadassana*" to "*anupādā-parinibbāna*", implies the happiness access through wisdom development. In fact, the happiness access through wisdom development based on the principle of holistic development that consists of four dimensions, namely: - (1) physical development, (2) moral development, (3) mental development, and (4) wisdom development. It can be clearly seen that the dimension of human's wisdom is an integrated vital part in

augmenting human intelligence to the maximum extent, which is to intellectually understand the nature and the universal states of nature as they truly are. Therefore, the access to happiness through the human wisdom is the perpetual happiness that human beings worthy deserve. It is happiness at a level that is extremely discreet. Even though the Biofeedback tools have been implemented to measure the accessible happiness but unfortunately it may be limited in areas of happiness in concentration (*samādhisukkha*) which dealing with only physiological responses. It is still necessary to conduct further researches with even deeper in order to be able to measure other higher levels of happiness.

In conclusion, the bi-dimensional development demonstrates that although the mind and wisdom are different in terms of dimensions but not different in their quintessence.

Conclusion

Happiness in the Concentration implies various states of mind that appeared in the context of the concentration while the Thirteen Dyads of Happiness in the Sukha-vagga implies the thirteen different pairs of happiness (*sukha*). They are in line with the Buddhist practices, such as the *Dhammasamādhi* that signifies the five kinds of virtues that make one to be firmness in the Dhamma; accessing through wisdom development, or access to happiness above happiness.

The way that GNH practice as the four pillars focusing on the middle path and contentment for individual and the social happiness. While biofeedback has a strength character, that is its tools. Biofeedback plays crucial roles as a tool to help practitioners realize happiness as well as to help increase an ability to assess the relationships between meditation progress and physiological responses in meditation phenomena. Finally, when all of the knowledge is integrated together, the Model named “A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process” is the output from MENTAL and WISDOM of life. Where “happiness” can be tangibly reached, they are (1) individual happiness while staying in the phenomenon of

concentration; and (2) social happiness, the 4 aspects of happiness as implied by Vajrayāna GNH.

Suggestions

1. Operational Suggestions

1) Practitioners of Buddhist monks, laity, academics and general interests should aware of knowledge in understanding and practice especially through the *citta-paññā* developing process in order to be able to access to the fivefold happiness in *Dhammasamādhi* using the biofeedback scientific tools.

2) Mahachulalongkornrajavidyalaya University, Buddhist Research Institute of MCU, educational institutes, and related Units should utilize the research's finding for general Buddhist teaching activities particularly the course of Seminar on Buddhism and Modern Sciences.

3) Meditation centers both domestic and international should utilize the "Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process" to their daily routine practice. However, the biofeedback process may be implemented together for the maximum result.

2. Suggestions for Further Research

1) Biofeedback Training Course for Memory Improvement: A Case Study of International Buddhist Studies College (IBSC) of Mahachulalongkornrajavidyalaya University;

2) Mindfulness Learning: An Integrated Method between Buddhist Mindfulness and Biofeedback Process to Enhance the Learning Efficiency of the International Students in Thailand;

3) Bliss (*sukha*) Access: An Integrated Method between Buddhist Concentration and Biofeedback Training Program to Enhance the Meditation Progress of the Practitioners".

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APENDIX II

Research Instruments

1

Form number □□□

In-depth Interview Questions Form

Objective: To collect data from key informants about the A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process

Key Informants: Monks and Buddhist scholars with knowledge of Buddhism and sciences, and who have expertise in interdisciplinary integration into education and way of life sciences

Research Title: A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process

.....

Instructions

1. Objectives of the Research
   1) To explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH).
   2) To examine the theory of biofeedback.
   3) To propose a conceptual model of bi-dimensional development for happiness access by biofeedback process.
2. All data obtained from this interview will be particularly used only to this research.
3. Each key informant receives one copy of interview form.
4. The researcher may conduct interviews by using a voice recorder.
5. This interview form consists of three parts;
   Part I: General Information of the Key Informant
   Part II: Information about opinion on specific issues
   Part III: Suggestions

Thanking you for your courtesy on this interview

(Asst. Prof. Dr. Sanu Mahatthanadull)
The Research Project Leader
Vice Director, IBSC, MCU.

Part I: General Information of the Key Informant

1. Name / Family name_____
2. Age_____
3. Occupation_____
4. Academic Position_____
5. Institute_____
6. Fields of Expertise _____

Part II: Information about Opinion on Specific Issues

Question 1: What do you think are the practices of happiness access according to Buddhist principle?

_____
_____
_____
_____
_____
_____

Question 2: Numbers of researches have been indicated that meditation or concentration (*Samādhi*) can significantly affects the physical body by affecting the body feedback; Brain waves, vital sign, heart rate, blood pressure, stress hormone, etc. This is called Bio-Feedback that underlines *Samadhi* as input can creates towards body feedback as output.

How does meditation work in the process of Mind-body in Biofeedback in your opinion?

_____
_____
_____
_____
_____
_____

Question 3: Based on the four dimensions of development in Buddhism, namely:- (1) Physical body development *(kaya-bhavanā)*, (2) moral development *(sīla-bhavanā*), (3) mental development *(citta-bhavanā*) and (4) wisdom development *(paññā-bhavanā*).

How are MENTAL development and WISDOM development related?

_____
_____
_____
_____
_____
_____

Question 4: From the following concepts about happiness access in Buddhism, Gross National Happiness (GNH), and the theory of biofeedback, what do you think of the features of the Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process should look like?

_____
_____
_____
_____
_____
_____

Part III: Suggestions

Do you have any suggestions or recommendations for the research team?

_____
_____
_____
_____
_____
_____

(End of question form)

APENDIX III

Invitation Letters

Memorandum

Division: International Buddhist Studies College, **Tel.** 0 3524 8000, **Ext.** 7210

No. AW 8013/W 038

Date **10 January 2019**

Subject: Kindly asking for in-depth interview for research

Enclosed: Interview from 1 copy

Dear Most Ven. Prof. Dr. Phra Rajapariyatkavi (Somjin Wanjan), Rector of MCU

According to the research project under the title "**A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number ๑.370/2560

As you are considered an expert in this area, **Asst. Prof. Dr. Sanu Mahatthanadull**, Head of the said research project, would like to interview you in order to collect the data to use in the research. Therefore, if you please to allow **him** interview you for the abovementioned purpose, the details in interview form are already enclosed herewith. Time and date of interview are subject to your availability and convenience.

So we, the International Buddhist Studies College, many congratulate on your rendering helps and thanks you very much for kingly cooperation at this time.

Yours in the Dhamma,

P. Dhammahaso.

(Venerable Phramaha Hansa Dhammahāso, Assoc. Prof. Dr.)

Director, International Buddhist Studies College

No AW 8013/w 069

MAHACHULALONGKORNRAJAVIDYALAYA UNIVERSITY
79 Group 1 Lamsai, Wang Noi,
Ayutthaya 13170, THAILAND
Tel. (6635) 248-000-5
Fax (6635) 248-034
URL : www.mcu.ac.th

10 January 2019

Dear Ven. Dr. Khenpo Karjung, Tango Dorden Tashithang Buddhist University, Bhutan

Subject: Kindly asking for in-depth interview for research

Enclosed: Interview from 1 copy

According to the research project under the title "**A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number ๑.370/2560

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Yours in the Dhamma,

P. Dhammaso.

(Ven. Phramaha Hansa Dhammahaso, Assoc. Prof. Dr.)
Director of International Buddhist Studies College

Office of Academic Affairs
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10 January 2019

Dear Ven. Dr. Khenpo Phuntsho Gyaltshen,
Director of Mahapanya Vidayalai (MPV), Songkhla, Thailand

Subject: Kindly asking for in-depth interview for research

Enclosed: Interview from 1 copy

According to the research project under the title "**A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number ๑.370/2560

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Director of International Buddhist Studies College

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10 January 2019

Dear Em. Prof. Dr. Peter Harvey,
University of Sunderland, United Kingdom

Subject: Kindly asking for in-depth interview for research

Enclosed: Interview from 1 copy

According to the research project under the title "**A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number ๑.370/2560

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Yours in the Dhamma,

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10 January 2019

Dear Prof. Dr. Phillip D. Stanley,
Naropa University, Colorado, United States

Subject: Kindly asking for in-depth interview for research

Enclosed: Interview from 1 copy

According to the research project under the title "**A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number ว.370/2560

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Yours in the Dhamma,

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10 January 2019

Dear Prof. Dr. Geeta Manaktala,
Panjab University, Chandigarh, India

Subject: Kindly asking for in-depth interview for research

Enclosed: Interview from 1 copy

According to the research project under the title "**A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number จ.370/2560

As you are considered an expert in this area, **Asst. Prof. Dr. Sanu Mahatthanadull**, Head of the said research project, would like to interview you in order to collect the data to use in the research. Therefore, if you please to allow **him** interview you for the abovementioned purpose, the details in interview form are already enclosed herewith. Time and date of interview are subject to your availability and convenience.

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10 January 2019

Dear Em. Prof. Dr. Pahalawattage Don Premasiri,
University of Peradeniya, Sri Lanka

Subject: Kindly asking for in-depth interview for research

Enclosed: Interview from 1 copy

According to the research project under the title "**A Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number ๑.370/2560

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P. Dhammaso.

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Director of International Buddhist Studies College

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10 January 2019

Dear Dr. Supriya Rai,
Director or K. J. Somaiya Centre for Buddhist Studies, India

Subject: Kindly asking for in-depth interview for research

Enclosed: Interview from 1 copy

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Yours in the Dhamma,

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Director of International Buddhist Studies College

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No 6113/2019

10 January 2019

Dear Ven. Phra Methavinairos, Assoc. Prof. Dr. Vice-Rector for Academic Affairs, Mahamakut Buddhist University

Subject: Invitation to be an IOC expert in the research

Enclosed: 1. Item-Objective Congruence (IOC) Form 1 copy
2. Interview Form 1 copy

According to the research project under the title "**A Conceptual Model of Bi-dimensional Development of Mind and Wisdom for Happiness Access in Life by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number ๑.370/2560

As you are an expert in this area, you are cordially invited to be an IOC expert in examining the Interview Form in this research. The researchers would like to congratulate on your rendering services and thanks you very much for your kind cooperation at this time.

Yours in the Dhamma,

(Asst. Prof. Dr. Sanu Mahatthanadull)
Head of Research Project,
Vice-Director of International Buddhist Studies College

Contact: Asst. Prof. Dr. Sanu Mahatthanadull
Mobile phone 081 407-9000
Email: petchsanu@gmail.com

Checked.
Dr. Methavinairos.
(P. Methavinairos, Assoc. Prof. Dr.)
10 January 2019.

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No 6113/2019

10 January 2019

Dear Assoc. Prof. Dr. Praves Intongpan, Department of Philosophy and Religion, Faculty of Humanities, Kasetsart University.

Subject: Invitation to be an IOC expert in the research

Enclosed: 1. Item-Objective Congruence (IOC) Form 1 copy
2. Interview Form 1 copy

According to the research project under the title "**A Conceptual Model of Bi-dimensional Development of Mind and Wisdom for Happiness Access in Life by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number ว.370/2560

As you are an expert in this area, you are cordially invited to be an IOC expert in examining the Interview Form in this research. The researchers would like to congratulate on your rendering services and thanks you very much for your kind cooperation at this time.

Yours in the Dhamma,

(Asst. Prof. Dr. Sanu Mahatthanadull)
Head of Research Project,
Vice-Director of International Buddhist Studies College

Contact: Asst. Prof. Dr. Sanu Mahatthanadull
Mobile phone 081 407-9000
Email: petchsanu@gmail.com

Approved
P.V. Intongpan
10 January, 2019

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URL : www.mcu.ac.th

No 6113/2019

10 January 2019

Dear Dr. Amnart Buasiri
Subject: Invitation to be an IOC expert in the research
Enclosed: 1. Item-Objective Congruence (IOC) Form 1 copy
2. Interview Form 1 copy

According to the research project under the title "**A Conceptual Model of Bi-dimensional Development of Mind and Wisdom for Happiness Access in Life by Biofeedback Process",** was granted for the research funding from Mahachulalongkornrajavidyalaya University, fiscal year 2560 B.E. by the Buddhist Research Institute, contract number ๖.370/2560

As you are an expert in this area, you are cordially invited to be an IOC expert in examining the Interview Form in this research. The researchers would like to congratulate on your rendering services and thanks you very much for your kind cooperation at this time.

Yours in the Dhamma,

(Asst. Prof. Dr. Sanu Mahatthanadull)
Head of Research Project,
Vice-Director of International Buddhist Studies College

Accepted.
Amj Buii

Contact: Asst. Prof. Dr. Sanu Mahatthanadull
Mobile phone 081 407-9000
Email: petchsanu@gmail.com

APENDIX IV

Item-Objective Congruence (IOC) Examination Forms

The Item-Objective Congruence (IOC) Form

Explanation: Please read the following interviewing questions then kindly give the scores according to the table of Item-Objective Congruence (IOC) whereas it is used to evaluate the items of the interviewing questions based on the score range from -1 to +1 as shown below:-

Clearly understand (Congruent) = +1
Unclear (Questionable) = 0
Not clearly understand (Incongruent) = -1

No.	Objectives and Interviewing Questions	IOC Score			Remarks
		+1	0	-1	
Section I: Happiness Access					
Q.1	What do you think are the practices of happiness access according to Buddhist principle?				
Section II: Biofeedback					
Q.2	Numbers of researches have been indicated that meditation or concentration (*Samādhi*) can significantly affects the physical body by affecting the body feedback; Brain waves, vital sign, heart rate, blood pressure, stress hormone, etc. This is called Bio-Feedback that underlines *Samadhi* as input can creates towards body feedback as output. How does meditation work in the process of Mind-body in Biofeedback in your opinion?				
Section III: A Conceptual Model					
Q.3	Based on the four dimensions of development in Buddhism, namely:- (1) Physical body development (*kaya-bhavanā)*, (2) moral development *(sīla-bhavanā*), (3) mental development *(citta-bhavanā*) and (4) wisdom development				

No.	Objectives and Interviewing	IOC Score			Remarks
	(paññā-bhavanā). How are MENTAL development and WISDOM development related?				
Q.4	From the following concepts about happiness access in Buddhism, Gross National Happiness (GNH), and the theory of biofeedback, what do you think of the features of the Conceptual Model of Bi-Dimensional Development for Happiness Access by Biofeedback Process should look like?				

Remarks: The items that have scores lower than 0.5 will be revised. On the other hand, the items that have scores higher than or equal to 0.5 will be reserved.

APENDIX V

The Utilization of the Research Findings

A Certifying Letter of the Utilization of the Research or Creative Work Mahachulalongkornrajavidyalaya University

November 26, 2019

Topic: The Utilization of the Research

To: Asst. Prof. Dr. Sanu Mahatthanadull

I, Venerable Phramaha Hansa Dhammahaso, Assoc. Prof. Dr. Director of International Buddhist Studies College (IBSC), Mahachulalongkornrajavidyalaya University, has utilized the research entitled "**A Conceptual Model of Bi-dimensional Development of Mind and Wisdom for Happiness Access in Life by Biofeedback Process**"

I hereby certify that the research findings of **Asst. Prof. Dr. Sanu Mahatthanadull et al.** are utilized as follows:

- ☑ Utilization of academic benefits, such as lectures, teaching and the development of teaching styles.
- ☐ Utilization of knowledge in Buddhism
- ☐ Commercial utilization, such as research and/or creative work to develop inventions
- ☐ Policy or national level utilization
- ☐ Objectives-based utilization / goals of the research / creative work

The period of utilization from November 2018 up to the present, in which the use of this research caused in good results as follows:

- As a guide line in applying the research findings to the teaching and learning process and activities in Buddhism and modern sciences for the students of the International Buddhist College (IBSC), MCU both monks, nuns, novices and laymen.

- As the body of knowledge that the faculty members at the International Buddhist College (IBSC) can productively apply to their self-practice for happiness access.

- The faculty members, researchers and students can use the body of knowledge of the research to further develop with their academic work in many dimensions. I certify that the above statements are true in all respects.

…….. Utilizer

(Venerable Phramaha Hansa Dhammahaso, Assoc. Prof. Dr.)

Director of International Buddhist Studies College

Mahachulalongkornrajavidyalaya University

A Certifying Letter of the Utilization of the Research or Creative Work
Mahachulalongkornrajavidyalaya University

November 01, 2019

Topic: The Utilization of the Research

To: Asst. Prof. Dr. Sanu Mahatthanadull

I, Asst. Prof. Dr. Nun Krissana Raksachom, Director of Master of Arts Program in Buddhist Studies, Graduate School, Mahachulalongkornrajavidyalaya University, has utilized the research entitled "**A Conceptual Model of Bi-dimensional Development of Mind and Wisdom for Happiness Access in Life by Biofeedback Process**"

I hereby certify that the research findings of **Asst. Prof. Dr. Sanu Mahatthanadull et al.** are utilized as follows:

- ☑ Utilization of academic benefits, such as lectures, teaching and the development of teaching styles.
- ☐ Utilization of knowledge in Buddhism
- ☐ Commercial utilization, such as research and/or creative work to develop inventions
- ☐ Policy or national level utilization
- ☐ Objectives-based utilization / goals of the research / creative work

The period of utilization from January 2019 up to the present, in which the use of this research caused in good results as follows:

- Integrating the research findings to the teaching and learning process both in the subjects "Seminar on Buddhism" and "Buddhism in English" for graduate school M.A. students.

- The faculty members and students can use the body of knowledge of the research in terms of their academic references both M.A. theses and research works.

- The faculty members, researchers and students can use the body of knowledge of the research to further develop their self-practice to access to the happiness in life.

I certify that the above statements are true in all respects.

asst. prof. Dr. Kritsana Raksachom

…… Utilizer

(Asst. Prof. Dr. Nun Krissana Raksachom)

Director of Master of Arts Program in Buddhist Studies,

Graduate School, Mahachulalongkornrajavidyalaya University

A Certifying Letter of the Utilization of the Research or Creative Work
Mahachulalongkornrajavidyalaya University

October 20, 2019

Topic: The Utilization of the Research

To: Asst. Prof. Dr. Sanu Mahatthanadull

I, Dr. Orachorn Kraichakr, Assistant Managing Director, Samrong Medical Hospital, has utilized the research entitled "**A Conceptual Model of Bi-dimensional Development of Mind and Wisdom for Happiness Access in Life by Biofeedback Process**"

I hereby certify that the research findings of **Asst. Prof. Dr. Sanu Mahatthanadull et al.** are utilized as follows:

- ☑ Utilization of academic benefits, such as lectures, teaching and the development of teaching styles.
- ☐ Utilization of knowledge in Buddhism
- ☐ Commercial utilization, such as research and/or creative work to develop inventions
- ☐ Policy or national level utilization
- ☐ Objectives-based utilization / goals of the research / creative work

The period of utilization from January 2019 up to the present, in which the use of this research caused in good results as follows:

- As a guide line in applying the research findings to the self-practice for the medical personnel: administrative officers, doctors, professional nurses, etc. of Samrong Medical Hospital.

- As the body of knowledge that the medical personnel at Samrong Medical Hospital can practically apply to their self-practice training for happiness access.

I certify that the above statements are true in all respects.

Orachorn Kraich

…… Utilizer

(Dr. Orachorn Kraichakr)

Assistant to Managing Director, Samrong Medical Hospital

APENDIX VI

Comparison Table of Output, Outcome, and Impact of the Research Project

Comparison Table of Output, Outcome, and Impact of the Research Project

Objective Achieved	Output	Outcome	Impact
Objective 1: To explore the concept of happiness access according to Buddhist principles and the concept of Gross National Happiness (GNH)	Body of knowledge of happiness access in Theravāda Buddhism And Vajrayāna GNH	A complete version of the research report /Five Chapters	Practitioners are fully aware of the access of happiness both in Theravāda Buddhism and Vajrayāna GNH
	Dual languages of academic articles and research work	Publication of academic articles and research report both in English and Thai version	Both International and Thai educational institutes are fully aware and ability in applying the access of happiness in both Buddhist schools
Objective 2: To examine the theory of biofeedback	Body of knowledge of the biofeedback theory	A complete version of the research report /Five Chapters	Practitioners are fully aware and can utilize the biofeedback in happiness access.
	Dual languages of academic articles and research work	Publication of academic articles and research report both in English and Thai version	Both International and Thai educational institutes are fully aware and ability in applying the access of happiness in both Buddhist schools
Objective 3: To propose a conceptual model of bi-dimensional development	Body of knowledge of the conceptual model of bi-dimensional development	A complete version of the research report /Five Chapters	Practitioners get access to the happiness in concentration as well as develop their skill of practice by using bi-dimensional development and biofeedback process

Objective Achieved	Output	Outcome	Impact
for happiness access by biofeedback process	Dual languages of academic articles and research work	Publication of academic articles and research report both in English and Thai version	Both International and Thai educational institutes are fully aware and ability in applying the access of happiness in both Buddhist schools

Biography of the Researchers

1. Researcher's Curriculum Vitae (Head of the Research Project)

1.1 Name-Surname

(In English)	Asst. Prof. Dr. Sanu Mahatthanadull
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1.2 Identification Number N/A

1.3 Present Position Vice Director

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1.5 Educational Background

B.A. (Advertisement) Bangkok University. (2538)

Certificate of Proficiency in English, School of Language and Communication, the National Institute of Development Administration (NIDA) (2544)

M.A. (Buddhist Studies) MCU. (2553)

Ph.D. (Buddhist Studies) MCU. (2556)

1.6 Areas of Expertise Area of Buddhist Sciences, Buddhist Integration, Buddhist Ecology, Buddhist Biology, Cultural Studies.

1.7 Experiences Related to the Research

1.7.1 Head of the Research Project

1) “Buddhist Biology: Life-Supporting Factors According to the Seven Suitable (*Sappāya*)” (Thai Edition). Research funded by the National Research Council of Thailand (NRCT) fiscal year C.E. 2014.

2) “The Five Precepts: Criterion and Promotion of Individual and Social Peace” (Thai Edition). Research funded by Thai Health Promotion Foundation, fiscal year C.E. 2015.

3) “A Study of the Holistic Well-beings Promotion for Balanced Way of Life according to Buddhist Psychology”. Research funded by the National Research Council of Thailand (NRCT) fiscal year C.E. 2016.

4) “Human Behaviors in Promoting Balance of Family according to Buddhist Psychology”. Research funded by the National Research Council of Thailand (NRCT) fiscal year C.E.2017.

5) “A Conceptual Model of Bi-dimensional Development for Happiness Access by Biofeedback Process”, Research funded by the National Research Council of Thailand (NRCT) fiscal year C.E.2017.

1.7.2 Co-researcher

1) “Strengthening the Emotional Strength of Professional Nurses: Principle and Buddhist Ideal, fiscal year 2016.

1.8 Address 59/229 Visuddhaville Village Soi 13 Rama Indra Road 103/1, Kan Na Yao Sub-district, Kan Na Yao District, Bangkok 10230.

2. Researcher's Curriculum Vitae (Co-researcher)

2.1 Name-Surname

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2.5 Educational Background

B.A. (English), MCU (2545)

M.A. (Buddhist Studies), University of Delhi, India (2548)

Ph.D. (Buddhist Studies), University of Delhi, India (2553)

2.6 Areas of Expertise Pali language, Buddhist Theravada Studies, Abhidhamma Studies.

2.7 Experiences Related to the Research

2.7.1 Researches

1) “The Creating and Developing Buddhist Happiness Indicators according to the Buddha’s Principle of Teaching”, 2015.

2) “An Analysis of Policies and Strategies of Buddhism and Cultural Tourism in ASEAN Community” 2017.

2.7.2 Articles

1) “An Analytical Study of the Factors Causing Sexual Deviation as Depicted in Buddhist Scriptures”, Horizon Research Publishing Corporation, Vol. 4 No. 10 0216, USA 2016.

2) “Sukhothai Kingdom: The Golden Age of Buddhism”, Journal of International Buddhist Studies, Vol. 7, No. 2, 2016.

3) “An Analysis of Policies and Strategies of Buddhism and Cultural Tourism in ASEAN Community”, Journal of Social Sciences Srinakharinwirot University, Vol. 192017.

3. Researcher’s Curriculum Vitae (Co-researcher)

3.1 Name-Surname

(In English) Dr. Orachorn Kraichak

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3.2 Present Position Special Lecturer

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3.4 Educational Background

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M.A. (Marketing), Ramkhamhaeng University (2549)

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3.5 Areas of Expertise Buddhism, Marketing, Management, Team Building.

4. Researcher's Curriculum Vitae (Co-researcher)

4.1 Name-Surname

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4.4 Educational Background

B.Econ. Thammasat University. (2542)

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4.5Areas of Expertise Economics, Family Studies, Theravāda Buddhism.

4.6 Experiences Related to the Research

1) Co-researcher of project “The Five Precepts: Criterion and Promotion of Individual and Social Peace” (Thai Edition). Research funded by Thai Health Promotion Foundation, fiscal year C.E. 2015.

2) Co-researcher of project “A Study of the Holistic Well-beings Promotion for Balanced Way of Life according to Buddhist Psychology”. Research funded by the National Research Council of Thailand (NRCT) fiscal year C.E. 2016.

3) Co-researcher of project “Human Behaviors in Promoting Balance of Family according to Buddhist Psychology”, Research funded by the National Research Council of Thailand (NRCT) fiscal year C.E.2017.

4) Co-researcher of project “A Conceptual Model of Bi-dimensional Development for Happiness Access by Biofeedback Process”, Research funded by the National Research Council of Thailand (NRCT) fiscal year C.E.2017”, Research funded by the National Research Council of Thailand (NRCT) fiscal year C.E. 2018.

5. Researcher’s Curriculum Vitae (Project Adviser)

5.1. Name-Surname

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(In Thai) พระราชปริยัติกวี, ศ. ดร.

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