

Intellectual Enhancement Based on the Four Foundations of Mindfulness “Satipaṭṭhāna 4” Training and the Scientific Brain Signal: Electroencephalogram

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Abstract - This article inspires the intellectual enhancement based on scientific and religious study areas; it primarily explores the reflective knowledge of the insight meditation “vipassanā” based on the four foundations of mindfulness called “satipaṭṭhāna 4” training that exerts on the frequency range on individual’s brain signal through an electroencephalogram (EEG) scientific system. The study has shown intellectual improvement in brain signal with constructive and dynamic outcome. The result conforms to the Buddhist insight-knowledge “ñāṇa” and “Satipaṭṭhāna sūta” in tipitaka that the practice of the insight meditation based on the four foundations of mindfulness leads to intellectual development and is the only path to attain nirvana or “nibbāna”.

Keywords - Brain Signals, Electroencephalogram (EEG), Insight Meditation “Vipassanā”, The Four Foundations of Mindfulness “Satipaṭṭhāna 4”

I. INTRODUCTION

This article emphasizes the cultivation of insight or wisdom “paññā” which is founded on the four foundations of mindfulness “satipaṭṭhāna 4” training. A person can learn the truth of nature “dhamma” by training mindfulness at every present moment, ignorance will be destroyed, and accurate knowledge or wisdom obtained. He or she can avoid the suffering of living and attain nirvana. From the study, the intellectual development based on mindfulness practice correlates with

the brainwave function constructively. An electroencephalogram (EEG) records the electrical activity of the brain and the brainwave patterns are closely connected to our body and mind such as physical activities, sensations and thoughts. In consequence, the interconnection of religion and scientific study will be productive and beneficial for everyone. The study can promote multidisciplinary Buddhist education as well as support the spread of Buddhism.

II. THE FOUR FOUNDATIONS OF MINDFULNESS “SATIPATTHANA 4”

The four foundations of mindfulness or “satipaṭṭhāna 4” is an intellectual exercise held in Theravāda Buddhism. The mindfulness training has been launched to develop moment-by-moment mindfulness: the mindfulness of the body, the mindfulness of the feelings, the mindfulness of the mind, and the mindfulness of the mind-objects. As the Buddha taught that: “There is this one way, monks, for the purification of beings, for the overcoming of sorrows and griefs, for the going down of sufferings and miseries, for winning the right path, for realizing nibbāna, that is to say, the four applications of mindfulness” (I.B. Hornor, O.B.E., 1995: 71) [1]. The structural model of the four foundations of mindfulness is revealed orderly as follows:

- 1) kāya, physical structure and activities.
- 2) vedanā, the emotional nature, first as bare feeling, then as having ethical implications.

3) citta, conscious life, consciousness or intelligence, considered under ethical aspects.

4) dhammā, with its subdivisions:

- the Five Hindrances;
- the Five Groups;
- the Six Spheres of Sense;
- the Seven Factors of Enlightenment;
- the Four Aryan Truths (T.W. and C.A.F. Rhys Davids, 1995: 325) [2].

Meditative practitioners are required to train themselves until they are able to recognize that everything inside oneself and in the world outside of oneself is constantly changing or impermanent (aniccā); dissatisfactory or suffering (dukkha); and uncontrollable or not belonging to oneself (anattā). These three basic characteristics are the true nature of all phenomena (tilakkhaṇa); consequently, they achieve the cultivation of insight knowledge (vipassanā ñāṇa). The four foundations of mindfulness are canonically indicated as the direct path to the realization of nirvana. This training aspires to progress the spirituality and intellectuality of all individuals from an average man to become a noble man, and a man of wisdom.

III. BRAIN SIGNAL: ELECTROENCEPHALOGRAM (EEG)

An electroencephalogram (EEG) is a test that measures and records the electrical activity of your brain. Special sensors called electrodes are attached to your head and are hooked by wires to a computer. The computer records your brain's electrical activity on the screen or it may record the activity on paper as waves. Changes from the normal pattern of electrical activity can show certain conditions, such as seizures (WebMD. 2017) [3]. The EEG frequency bands from low to high frequencies are called delta, theta, alpha, beta and gamma. In this study, EEG frequency is revealed 4 levels including delta, theta, alpha, and beta. The alpha and beta wave were

introduced by Berger in 1929. Jasper and Andrews (1938) used the term gamma to refer to wave of above 30 Hz. The delta wave was introduced by Walter (1936) and he also introduces theta wave (S. Saeid, 2007: 10) [4].

The brain works using a signal processing as the brainwave. It state always affect our life. The brain has nerve cells that fire electrical signals and oscillate in distinctive arrangements called brainwave patterns. These patterns are connected to our thoughts, emotions, moods, biological chemistry, everything we act, and everything we are. It is helpful to study the different brainwave states in order to understand their developmental functions:

1) **Beta Brainwave Frequencies: 13-40 Hz**

The beta brainwave is the predominant frequency when we are fully awake and alert. It is active awareness directed to the outer world. Beta brainwaves are present during stress, paranoia, worry, fear, and anxiety. They are also present during hunger, depression, irritability, and moodiness. Insomnia is the result of producing excessive beta brainwaves. It is associated with excessive “mental chatter” and self-destructive impulses. Spending too much time in the beta state weakens the immune system.

2) **Alpha Brainwave Frequencies: 7-13 Hz**

The alpha state is where meditation and relaxation begins. We start to encounter the wealth of effortless creativity flowing just beneath our conscious state. It explores awake but deeply relaxed. In the alpha state we learn, process, memorize and recollect large sums of information fast and with peak effectiveness. Alpha brainwaves are thought to make the brain “act young” again. In the alpha state fears, habits, and phobias begin to melt away. They bring an effortless sense of comfort, peace, and harmony and are best for “super learning”. The alpha state is the first layer of our subconscious mind and a gateway to deeper states of awareness.

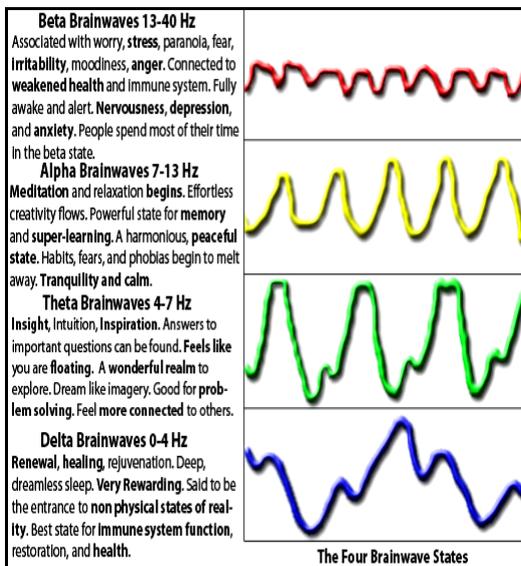
3) **Theta Brainwave Frequencies: 4-7 Hz**

Theta brainwaves become prominent when we go deeper into meditation and relaxation,

almost trance-like. The brain activity decelerates to the threshold of the sleep stage. One of the more indescribable and wonderful realms we can explore. The theta state produces flashes of creative visualization through vivid imagery. In this state we feel much more open and connected to other people. People often report a feeling of floating while producing theta brainwaves. They are thought to bring out a person’s dormant extrasensory perception (ESP) skills and inspire thought and increased motivation. The theta state heightens problem-solving skills. Having dominant theta brainwaves are correlated with insight and intuition. Sometimes long-forgotten memories come to the surface. Children have strong theta brainwaves, which helps to explain their superior ability to learn. Theta is briefly experienced as we climb out of the depths of delta upon waking, or when falling asleep. It is the deeper sub-conscious to super-conscious part of the mind.

4) Delta Brainwave Frequencies: 0-4 Hz

Delta state is the deepest level of meditation. It is associated with “no thinking” during deep, dreamless sleep. Delta brainwaves are very rewarding. Delta is said to be the entrance to non-physical states of reality, a crucial state for renewal, healing, and rejuvenation. The immune system strengthens in the delta state. The delta state is the unconscious/super-conscious part of our mind. Many scientists believe this state to be the most beneficial.



(Brain Wave Wizard, 2017) [5]

IV. THE ANALYSIS OF INTELLECTUAL ENHANCEMENT BASED ON THE FOUR FOUNDATIONS OF MINDFULNESS “SATIPATTHĀNA 4” TRAINING AND THE EFFECTS OF SCIENTIFIC BRAIN SIGNAL: ELECTROENCEPHALOGRAM

As we know the four foundations of mindfulness or “satipaṭṭhāna 4” leads to the development of intellectual abilities apprehended in Buddhism. Its training produces fruitful changes in both body and mind. Apart from its religious impact, the scientific brain signals of individuals’ change accompanied with the four foundations of mindfulness training has been revealed in this article as well.

In keeping with the quasi-experimental research, we aim to study the development of the four foundations of mindfulness and its achievement of the insight-knowledge from beginning to end 16 levels (soḷasa-ñāṇa) and to analyze the effects of meditative practice based on its evaluation via 16 standardized insight-knowledge levels towards the brain signal: electroencephalogram (EEG) by scientific system. The purposive sampling group of 44 persons who meditated in the four foundations of mindfulness or “satipaṭṭhāna 4” a month retreat with pre - and post - brain computer interface measurement, questionnaires writing, and insight interview sessions. The following results were obtained:

1) The collected data reveals that the meditative participants understand the four foundations of mindfulness in a more profound level, which resulted in a 7.44% increase based on pre- and post-questionnaires.

2) The study of the achievement of the 16 insight-knowledge levels based on insight interview sessions by the expert meditative masters shows that the beginning meditative participants are able to achieve the insight-knowledge levels 1 through level 4. In addition, the experiential meditative participants can attain the insight-knowledge level 1 to level 11. Both groups appreciated the value of the four foundations of mindfulness practice; though, they are still on the secular insight-

knowledge level which can deteriorate.

3) To study the statistical mean score of individual frequency of electroencephalogram after a meditative retreat:

- The statistical mean score of individual frequency of EEG of the beginning meditative participants shows that the highest increased

figure are delta waves (0.353), followed by theta waves (0.169), high beta waves (0.139), beta waves (0.073), and lastly alpha waves (0.044) (Phrarajsitthimuni (Vi.), Dr., Piyadee Prasertsom, Dr., and Yodchanan Wongsawat, Asst. Prof. Dr., 2015: Abstract) [6].

TABLE I

Test (n=20) Mean	Delta (1-4Hz)	Theta (4-8Hz)	Alpha (8-12Hz)	Beta (12-25Hz)	High Beta (25-30Hz)
Pre Test	0.343	-0.068	-0.308	-0.408	-0.055
Post Test	0.696	0.101	-0.265	-0.335	0.084
Post-Pre	0.353	0.169	0.043	0.073	0.139

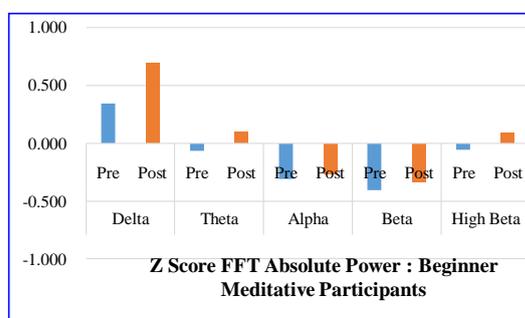


Fig. 1 A Graph of Individual Frequency of EEG of the Beginning Meditative Participants

The figures expose that the meditative retreat supports beginner meditative participants to increase their deepest levels of relaxation, healing, and rejuvenation, which is a very helpful brain wave range. They experienced good attributes of maintaining conscious awareness, intuition, and solution solving; however, the beta waves also slightly raised up which exhibits the presence of stress, fear, anxiety, or irritability. This occurrence identifies the sign of nīvāraṇa or the five hindrances, including sensual desire or kāmachanda, ill will or byāpāda, sloth and torpor or thīna-middha, distraction and remorse or uddhaccakukkucca, and doubt or vicikicchā. Any problem which arises in meditation will be one of these five hindrances, or a combination. These five states are the obstacles to the development of mental and intellectual quality, and the beginning meditators should focus on and overcome

them by intensive practicing of the four foundations of mindfulness. In the insight meditative retreat, the beginners should have the four favorable conditions or sappāya, which are a suitable calm place, healthy food, a good teacher and spiritual friend, and suitable dhamma and practice. The four foundations of mindfulness training implies to get acquainted with natural phenomena or sabhāvadhamma as they really are. The beginning meditators should contemplate their body, feeling, mind and mental phenomena under the insight conditions of the persistent energy (ātāpī), the mindfulness (satimā), and the awareness (sampajāno) (Phrarajsitthimuni Phramaha Boonchit Sudprong, Dr., 2014: 75) [7].

- With the experiential meditative participants, the study shows that a meditative retreat helps improve the brain function especially with regards to intuition. The statistical mean score

reveals that the highest increased score are (0.038). On the contrary, beta waves (-0.077) and high beta waves (-0.063) are lessened. theta waves (0.078), followed in second by alpha waves (0.046), and then delta waves

TABLE II

Test (n=20) Mean	Delta (1-4Hz)	Theta (4-8Hz)	Alpha (8-12Hz)	Beta (12-25Hz)	High Beta (25-30Hz)
Pre Test	0.211	-0.121	-0.476	-0.466	-0.167
Post Test	0.249	-0.043	-0.430	-0.543	-0.230
Post-Pre	0.038	0.078	0.046	-0.077	-0.063

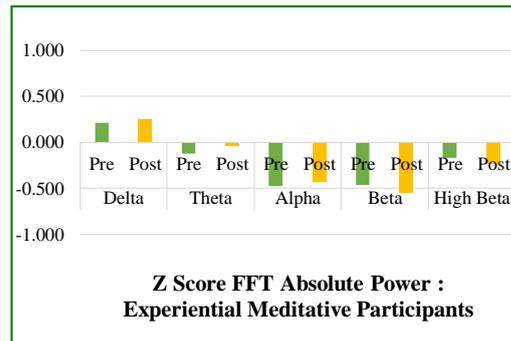


Fig. 2 A Graph of Individual Frequency of EEG of the Experiential Meditative Participants

From this study, it explores a constant retreat of the four foundations of mindfulness practice that promotes quality of deep relaxation and intuition; moreover, it reduces anxiety and stress since the retreat helps individuals increase their low frequency range of EEG and decrease their high frequency range of EEG. All individuals are recommended to continuously practice in a retreat of the four foundations of mindfulness to achieve maximum benefit. This scientific result conforms with the discourse of Buddha in Satipaṭṭhāna sūta that it is the only way for the purification of beings, for the cessation of sorrows, and for attaining nirvana (Phrarajisitthimuni (Vi.), Dr., Piyadee Prasertsom, Dr., and Yodchanan Wongsawat, Asst. Prof. Dr., 2015: Abstract) [8].

V. CONCLUSION

With the religious part, the result is shown that the individuals who practice in the insight meditation “vipassanā” course based on the four foundations of mindfulness “satipaṭṭhāna 4” are able to develop their intellects. In

general, flourishing practice makes possible to relieve depression, many stress-related diseases, and at the very least add joyfulness to life. All individuals who genuinely learn the mindfulness can cultivate their healthy physical appearance, mental quality, and intellect at the present moment. They are enabled to understand how to control the mind when it goes the wrong way. They get knowledge of the right way and the skillful means to make the mind create calmness, intellect, and true happiness of life. At last, the most important purpose of “satipaṭṭhāna 4” is to purify the mind from all defilement, for developing higher knowledge of noble quality, and finally for the realization of nirvana.

With the scientific part, the four foundations of mindfulness or “satipaṭṭhāna 4” practice is recognized as alternative or natural medicine to enhance the mind's capacity to affect brain system and bodily function. The insight meditators contemplate the body, the sensations, the mind, and phenomena, respectively, through each and every moment of practice. They can improve their physical and mental health

because of their equanimity of mind. Its practice is the tendency of lessening anxiety, stress, blood pressure, and various symptoms. It can balance the mind and body systems that are relatively inseparable. In addition, the scientific (EEG) outcome of individuals also conforms with the insight-knowledge outcome, both results support the discourse of Buddha “satipaṭṭhāna sūta” in tipīṭaka that practicing the four foundations of mindfulness “satipaṭṭhāna 4” is the only path for the purification and the cessation of sorrows.

In conclusion, all individuals are proposed to habitually practice in the four foundations of mindfulness “satipaṭṭhāna 4” training to gain peaceful living, and, moreover, to achieve maximum benefit of intellectual enhancement to wisdom “paññā”. All received knowledge enables us to encourage the realistic connections of science and religion, to raise academic standards and integrity, as well as the propagation of Buddhism.

VI. KEYWORDS

1) “*Brain Signals*” or brain waves display the different types of electrical patterns across the cortex. The brain signals can be observed with EGG. Each brain signal has a purpose and helps serve in optimal mental function.

2) “*Electroencephalogram (EEG)*” is a test that measures and records the electrical activity of the brain.

3) “*The Four Foundations of Mindfulness*” or “*Satipaṭṭhāna 4*” is setting up of mindfulness, including: contemplation of the body; contemplation of feelings; mindfulness as regards feelings, contemplation of mindfulness; and contemplation of mind-objects.

4) “*Insight Meditation*” or “*Vipassanā*” means insight; intuitive vision; introspection; contemplation; intuition; insight development.

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(Arranged in the order of citation in the same fashion as the case of Footnotes.)

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