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Future and Prospect of "Hanja Education" in the Age of Fourth Revolution (Artificial Intelligence) -Through the activation of "frontal lobe" in the area of brain science

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Abstract: *Hanja is mostly semantic-oriented logographic, but there are signs that indicate sound. Therefore, Chinese characters using Chinese characters are classified as syllable characters (logosyllabary). Hiragana, one of the Japanese systems of letters, is a syllabary that represents syllables. One interesting fact is that the brain circuits involved in reading each character system are different. There is a reason why I can not. In order to recognize the Chinese characters such as Chinese characters, the visual information and the concept system must be connected. In order to understand the phonetic characters, the visual and auditory memories and the phonological elements must be connected to each other. Most characters such as English, Korean, Chinese, and Japanese are mixed with factual and phonetic elements, so phonological and semantic analysis are required at the same time, and abundance of cerebral cortical resources must be activated. In the brain of a reader who reads Chinese, which is much larger than the alphabet of English or Korean, the right hemisphere of the brain intervenes more extensively. This is because the characters in the table require significant visual processing power and spatial analysis power. It is also said that the frontal motor memory related area is much more active when reading Chinese. It is presumed that it is probably because it learns by repeating and writing directly at the beginning of Chinese character learning.*

Keywords: *Artificial intelligence, hippocampus, amygdala, cerebrum, frontal lobe, prefrontal cortex, brain plasticity*

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I. Three Types Of Brains In Our Body

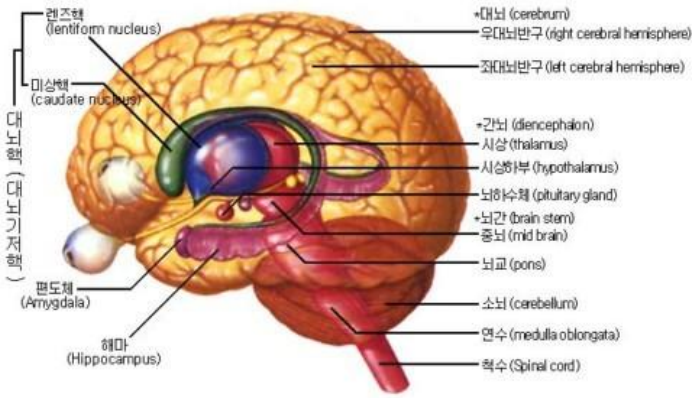
Although we are evolved and became more advanced "human beings" than animals, we still retain primitive and primordial brain and physical reactions. Brains are mainly classified into brain stem, which is referred to brain of reptile, limbic system, which is referred to a brain of mammal, and neocortex, which is a brain of human beings. As the beside picture shows, brain legion is located innermost part of brain, limbic system on the brain stem, and cerebral cortex is placed on the system.

1. Brain Stem: Brain of Reptile

Brain stem is primitive and the oldest one among three brains. This brain of reptile involves functions needed for survival such as breathing, swallowing, cardiac impulse, body temperature, and balance. You may see reptiles such as snake or lizard in television or in the zoo. Most of them are static and remain dormant for long time. Although they have basic functions for maintaining life, they almost do not have functions that enrich life compared to other animals or human beings.

There are many similarities between babies and reptiles when you observe what born babies act. They spend most time in sleeping, are not conscious of surroundings unless they are directly influenced, and do essential things required for survival. When they are born, brains of mammals and human beings exist anatomically, yet babies conduct basic functions in a primordial level as their brains except for reptile brains are not completely working

Fighting, running away, and staying stupefied are mechanism against threats are major functions responsible by reptile brains are serve as significant roles in controlling emotion. We will look at this in a later part.



<Fig.1 - Brain Structure >

2. Brain Of Mammal That Loves, Hates, And Memorizes

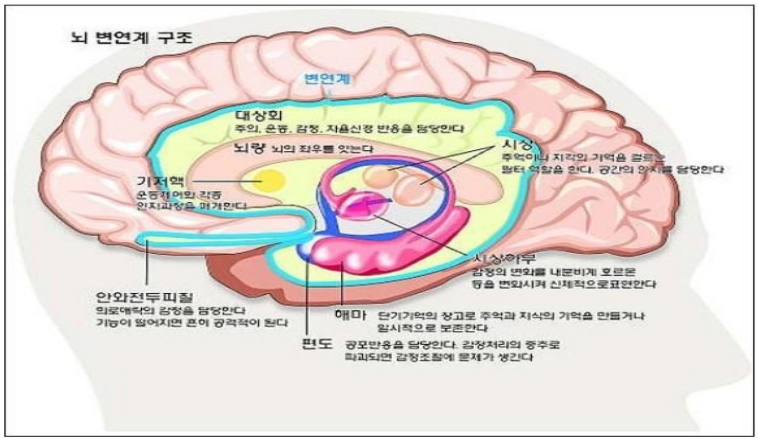
Brain limbic system, more evolved from brain stems of reptiles, takes charge of memorization, attachment, and emotion. Limbic system are held responsible for memorization, attachment, and emotion. Hippocampus and amygdala are noted as the most essential organs for emotion control in the limbic system. Let us examine it in more details.

1) Hippocampus

Hippocampus plays roles in the process of memory and experience. Memory we generally say is stored here. Saves memories have narratives, which are composed of beginning, middle, and end. These memories are typically formed based on time, space, emotion, and meaning. Even if it fades away as times progresses, they are likely to recur if there are stimuli that reminds them. Emotion should be gauded to save them into hippocampus. Experience that triggers no emotion is considered valueless and not saved; similarly, overstimulated and overwhelmed emotions are not preserved in hippocampus. Experiences we generally call between emotional decline and hyperarousal are stored in hippocampus. It remains anatomically from when we are born and it takes 24 or 36 months to function. The typical reason why we do not recall before two-year-old is that memories are not saved due to immature hippocampus. Memories involved with unaccumulated strong emotions are ssaved in our body and amygdala.

2) Amygdala

Amygdala functions as a fire alarm in our body. Just as fire alarm recognizes flame(danger) and emits alarm that enables us to cope with in fire situation(dangerous situation), amygdala perceives threatening or dangerous signals to our survival among information coming through thalamus. When it recognizes a dangerous one, it enhances the likelihood of survival by sending signals to body and brain for us to take proper measures. Nevertheless, amygdala are not able to distinguish threatening or not when it perceives danger and transmits the same signals to body and signals just as fire alarm indiscriminately rings up without determining whether it rang up for fire or cooking.



<**Fig. 2 –** Structure and Functions of Limbic Brain>

Here lies in the very reason why many patients with panic disorder generally drip with lots of sweats and feel terrified in normal situations. Literally amygdala sends signals to body and mind as it perceived trivial stimulus as a dangerous situation due to its malfunction as fire alarm is sensitive to cigarette smoke as to operate alarms.

Amygdala also saves memories. Those preserved in amygdala are stimulated by extreme infuriation, terror, and fear. They are devoid of plots, time, and space contrary to memories stores in hippocampus. Since a single part was dissociated from the entire experience, and time continuity or space concept are not connected and stored by parts, memory saved in the limbic system is stimulated and story or context disappears like happening in that space, thus stuck eternally in terrible experience. This is not the way "memorizing" the past experience, but "re-experiencing" the same frightening situation. Examples include flashback, nightmare, and physical sense.

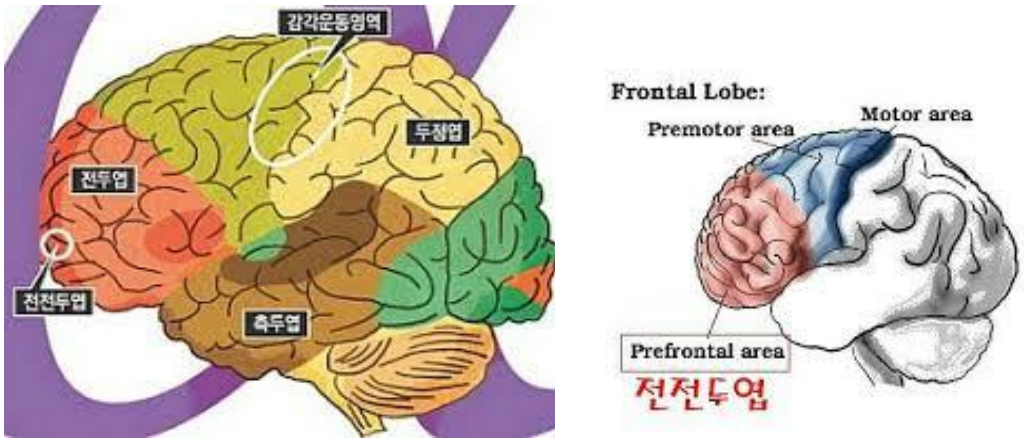
For flashback, films on the Vietnam War or holocaust survivors show situations rapidly turn into war fields and victims undergo extreme terror when their past trauma is stimulated by fragmentary stimuli such as certain noise or odor, although they remain in placid situations. Someone may think that it will be film production for dramatic effect, yet it is totally misunderstanding. As flashback occurs, they experience the same feeling they had in the past. In this moment, they forget the fact that they survive and live with family. Threat detection and its natural response are directly associated with survival so that limbic system functions properly when we are born. Young children who are painful with trivial discomforts are caused by the limbic system.

3.Could Become Dalai Lama: Human Brain

Amalygdata is located the most top among three brains and developed far later in terms of evolution. Although other mammals have this, human beings has more thicker one. It controls reason and thinking, which are distinct abilities from other animals. Frontal lobe, in particular, functions as sharing talks with other parts, guiding, and arbitrating like a conductor. It reserves more advanced cognitive functions including enabling us judging which is proper for social decorum and setting plans. The recent study found that it gradually starts to work at the age of 12 months, and grew into mature at the age of 25. In the United States, driver insurance costs significantly drop from 25-year-old, because statistics showed that the possibility of accidents dramatically diminishes around that age. We came to learn what we had not thanks to the development of neuroscience and a great deal of things we learned from experience were confirmed by important results from neuroscience studies.

** Prefrontal Cortex**

Dr. Daniel J. Siegel noted the particular importance of prefrontal cortex and he claimed that it helps us (1) return to comfortable status after getting stressed out or performing actively by adjusting our body through autonomic nervous system, 2) feel what other people feel and experience telepathy while taking with others, 3) feel secured and actual emotions by adjusting not to exceed the adjustment extent (maintaining more or less moderate emotion neither hyperarousal nor emotional decline). In addition, it helps us 4) look current situation and available options before doing something, and decide the most appropriate behavior in minds, 5) feel sympathy and understanding of others through empathy, 6) understand that I experience several opposing moments in a variety of places, 7) alleviate fears by releasing neurotransmitter Gamma Amino Buteric Acid(GABA) that promotes to relieve amygdala, 8) let us do reasonable behaviors in spite of being alone and act according to social benefits and good, and convert accepted information from body into mental process.



<Fig. 3 – Frontal lobe and Prefrontal cortex>

If human brains, particularly prefrontal cortex, works well, many problems we encounter in daily life will be removed. If these nine functions of prefrontal cortex function properly, anyone can be Dalai Lama.

However, the main problem is that cerebral cortex including the powerful prefrontal cortex is powerless against overwhelming emotion. In this situation, quantities of information transferred from amygdala to frontal lobe are more than vice versa. It is the same as ten teachers try to control all chattering middle school students. Emotion control is vital for proper work of prefrontal cortex.

<Fig. 4 – Functions and Roles of Frontal Lobe and Prefrontal Lobe>

II. Brain That Reads Books

1. **Language Development**

A development stage provided by Piaget suggests that mental techniques such as language, reason, and abstraction are composed by overlapped techniques including pattern awareness, calculation, and physical intuitive (knowledge obtained by babies by tapping, tearing, and pulling objects). Over the past decade of scientific development, these basic techniques were verified. As evaluation and improvement methods were developed, educators can show remarkable achievements.

2. Written Language

The initial character system emerged in arts around 5,000 and 10,000 years go(cave painting considered as art activity or characters). Afterwards it changed as character system propagated farther. The symbol of sun in the ancient sumerian letters used in 3,100 B.C. were two semicircles representing the sun lighting the valley between mountaintops. They were progressively transformed and evolved.

Character symboled started to used by summerians between 3,330 BC and 3,200 BC represented object images. Although they represented pictorial symbols, and gradually developed into abstract cuneiforms. Since it resembles wedge by writing them with the edge of reed on soft mud surface, it is referred to as cuneiform or arrow-headed letters. Special exploration on brain circuit is not needed to understand signs used for helping people imitate nearing objects or remembering numbers. However, nominal education and intended training are necessary to recognize and understand completely different characters as character system starts to be abstract. In other words, character symbol requires more particular cognitive reorganization.

3. **Brain in the Digital Era**

It is almost impossible to distract in the digital age in which information floods anywhere. Most people surrendered into multiple stimuli. When numerous information aims to attract our attention, we flip through and pass away instead of reading books closely, listening to what other people speak, and paying attention. What is worse, the ability of memorizing information was retarded as our life is linked with telecommunication. We do not have to keep telephone numbers in heart or imagining driving courses. Why do we have to memorize information and numbers even if we can get access to the Internet with our smartphones anywhere and anytime?

It should not arrive at the conviction that what effects will be brought by this life. In short, it is expected that hippocampus Information related with emotion are deeply entrenched than another information. Thereefore, it is likely to be saved for long periods. When someone feel despearate or sorrowful by hearing the news such as bridge collapse or school gunshot, it is likely to be memorize it. In addition, hippocampus memorizes information you consider proper or unique. It is understandable in terms of evolution. Hippocampus selects certain valuable information to be transferred to cortex, although it accepts much information. Flipping

through without memorizing information depends on frontal lobe not hippocampus. By contrast, frontal lobe and hippocampus are needed for intensive learning. Therefore, hippocampus will be weak unless memorizing exercise is not regularly done. Healthy hippocampus is a critical factor for reinforcing current brain functions and reducing the risk of dementia. This is another reason why we need to spare time for keeping memory exercise.

III. The History Of Brain Reading

Reading is not an inherent ability. Human invented reading a couple of thousands years ago. They reorganized brain structure with this inventive work and this reframed brain expanded our thinking, thus leading to the change of cognitive development. Reading is the best invention in human history and historical records is one of results. As our precedessors did, exceptional abilties of our brain was the main cause of this greatest invention. Human brain can make new connections within the previous structure. It is available due to its alterable forms according to experiences.

Plasticity is the core characteristic of brain structure, which act as basis of many things that constitute the present and future.

Reading brain is being converted into digital brain during this contemporary period. Therefore, it is more important to understand what our brain needs for reading books, and how it contributes to figure out thinking, emotion, inference, and understanding other people. Sometimes we are faced by complicated problems in terms of evolution, yet they provide monotonous but new approach on methods that can teach the essential point of reading process. This can be applied to all the people including people ready for reading and those who have different brain systems like reading disorder such as dyslexia.

Brain is a pre-programmed unique hardware system according to gene commands through a couple of generations. Understanding reading brain and incapable one helps our knowledge develop for unexpected and valuable direction. This should be explored on continuous ways.

Brain was formed long periods ago in terms of human evolution and possesses more structures and circuits used in basic process than vision and language. The fact that brain can learn reading implies that it is versatile to make new connects by using previous structures and circuits. It is generally known that neurons make new connections whenever new things are accepted. Likewise, computer scientists call the system that accepts diverse orders by changing or arranging forms as "open architecture." Even if human brain has very limited genetic resources, it is the representative example of open architecture. Due to this design, we are naturally programmed to change and surpass what we are given. Thus, people are fit to genetic innovation. Brain that read books is composed of highly successful two-way dynamics. Reading can be learned as brain consists of plasticity. Reading means that there is an irreversible change physiologically and cognitively in our brain. For instance, those who read Chinese use totally different neuron connections compared to those who read English in terms of neuron. When Chinese user initially reads English, that brain employes a neuron path based on Chinese language. By learning Chinese reading, "brain that reads Chinese" was literally formed.

Similarly, what we think and content has basis on insights and imagination from what we read earlier. Writer Joseph Epstein is proper to quote here: "what he read and when should be written in details to write his or her biography. In a sense, people reflects what he or she read."

It is hard to find the case by integrating the development of brain reading with these two aspects: personal and intelligent aspect and biological aspect.

The automatic neuron path needed in recognizing letter, character pattern, and words can be done by another important aspect in retinotopic map, object awareness capacity, and brain tissue. This aspect refers to an ability to "represent" highly learned information patterns in specific parts. For example, cellular network in charge of recognizing characters and its patterns fires together and creates representations on visual information. Moreover, the withdrawal of this representation continues more rapidly. Representation can be formed without visual information when cellular network learns how to cooperate for long time. Stephen Kosslyn, a cognitive scientists at Harvard University, showed this fact clearly in the following experiment.

He asked adults who read passages in a brain scanner to close their eyes and imagine certain letters. As he asked them to come up with capitals, discrete part shares a part of visual field in visual corext showed reaction. Moreover, he asked them to imagine small letters and different discrete parts reacted. It implies that mere imagining letters can activate certain neurons in visual cortex.

When information enters through retina, intelligent brain that reads books processes a series of neurons characterized by physical features, thus automatically sending character information into deeper another visual processing area. This is the core area of its practical automatic process ability. Visual process as well as all representations and processes are easily fired rapidly.

The author started to concern about this unique aspect while thinking of this world where Google program is widely used. If tremendous amounts of information are moved into instantaneous computer texts, will an essential constructive factor start to change and weaken?

In other words, will sufficient time and motive to process information critically when visually complete visual information is given at the same time as most digital texts does? Will it be helpful in the development of child thinking as more potential information can be obtained through hyperlink texts? Even if children perform multitasking and develop abilities to absorb information infinitively, will constructive dimension be sustained? Should we instruct how to read it nominally according to various methods through which texts are given to learn diverse information process methods?

While reading, many of them go astray and become distracted. This associative aspect is not negative, but constitutes core generative advantages. About 150 years ago, Charles Darwin identified the similar principle in creation. In other word, "infinite" form is evolved from finite principle. He said "very beautiful and infinite forms evolved from the very simple beginning, and this process goes on." Character language also does. Reading enables us to create numerous beautiful and excellent thoughts beyond "given information" biologically and intellectually. Now we obtain, process, and figure out information in a new way compared to the present. Nevertheless, this essential advantage should not be missed.

IV. Metacognition and Brain Mechanism

We perform metacognitive activities every day. Only human beings can do this, which is an ability that thinks about personal thinking process, can be implemented only by human beings. Metacognition is incorporated with intelligence and induces us to successful learners in relation to learning.

Metacognition is a high-level thinking process that actively controls cognitive process. Accordingly, metacognition in charge of supervision and control is referred to as high-level "frontal lobe cognitive activity" in terms of brain science.

In terms of brain science, learning means a process of storing information from environment, and memory is a process of reproducing and withdrawing preserved information. Cerebral cortex as well as several areas and structures in brain join the process for learning and memory; in particular, memory is reported to be scattered in every part of cerebral cortex and preserved twice. Neurons in our brain undergo physical and chemical change due to learning. Examples include the change of synapse circuits, which are connection parts between neurons and the change of neurotransmitters secretion amounts, which are chemical transmitters between synapses. Thus, cerebral cortex is central in learning process that stimulates physical and chemical shifts in our brain. The highest-level thinking process, metacognition, is closely associated with effects of cerebral cortex. Particularly, frontal lobe―central in high-level and creative thinking, as well as critical thinking―is definitely pivotal.

The recent brain science reported that metacognition has connection with frontal lobe as well as limbic system in charge of prefrontal, eye frontal lobe, working memory, and affective aspects. This indicates that metacognition is directly connected with the highest-level thinking ability, memory ability, and emotion. In other words, this activity results from comprehensive joint works by diverse brain parts such as frontal lobe, working memory, long-term memory, and limbic system.

In particular, "cognitive aspect" among three different aspects of metacognition includes "long-term memory and frontal lobe activity"; "control aspect" includes working memory and frontal lobe activity; "definitive aspect" includes "a joint activity between limbic system and frontal lobe." However, they are not independent, but a comprehensive cognitive activity by using integration by parts. Therefore, "comprehensive and high-level thinking that shows the activities of forebrain" can be another characteristic in terms of brain science. In short, metacognition can be a frontal lob cognitive activity, and a comprehensive and high-level thinking that exhibits activities of frontal lobe at the same time.

Definitive aspect of learner influence metacognition. In other words, personal faith, attitude, affection, and emotion may give enormous effects on activity ways or learning methods. In addition, learners will actively use their metacognitive abilities if their attitudes are positive. On the contrary, when learners have negative attitude and awareness on their capability, they are hesitated with using metacognitive ability or give up using it. Hence, emotion aspect of learners prior to studying influences the utilization of metacognition. Learners also are content and pleased to control their awareness and feel confidence. Internal motivation will elevate despite the lack of external rewards by using metacognition, thus they will be autonomous learners. In short, metacognition allows learners to participate in active studying and provide them with internal motivation for continuous learning.

In consequence, they will have positive perspective on their identities and participate in studying voluntarily. Moreover, metacognition offers internal motivation that allows learners to keep studying without any external reward or motivation. It affects learners, and ultimately their ego concepts. Emotional aspect in association with metacognition is directly linked with the limbic system.

This system plays a central function in adjusting emotions such as pleasure, anger, and terror. It is closely associated with the function of frontal lobe. Accordingly, proper stimulus facilitates the activity of frontal lobe and gives positive effects on learning. However, when excessively negative emotion is evoked,

frontal lobe is inhibited by the limbic system based on defense mechanism. This in turn interrupts efficient learning. When they are stressed out, cortisol is secreted in adrenal. This hormone reduces the immune system, causes muscle strain, and increases blood pressure. However, chronically high secretion of cortisol causes troubles in memory formation. In other words, chronic stress gives adverse effects on both short-term memory and long-term memory, and further affects metacognition that uses working memory. Intimidating environment also dysfunctions intelligent brain activity and only allows predictable and entrenched thinking and behavior. When someone is under threatening circumstance, amygdala circuit, which is a center for immediate response to threats or terror, works so that intelligent frontal lobe remains inactive. Therefore, learners are inclined to be survival-oriented in this intimidating and stressful environment and intelligent metacognition do not function properly. In contrast, the active use of metacognition helps learners to have good emotion, which enhances learning effects. They can feel content and pleasure by identifying their own cognitions spontaneously, thus promoting the secretion of endorphin and dopamine.

Endorphin reduces physical and mental fatigue, and activates brain activities. It also helps people feel happiness and pleasure, and have positive emotions. Through this process, people have internal motivations and their study efficiency will improve. Dopamine functions as a neurotransmitter that delivers awakening and pleasure. It is used as a neurotransmitter in A10 nerve among A-type nerves that triggers pleasure by stimulating brains in brain stems. A10 nerves spread to limbic system, frontal lobe, temporal lobe, and frontal association areas. Yet there is no autoreceptor nearby frontal lobe at the end of A10 nerve, which indicates that minus feedback does not work. In other words, the activation of plus feedback does not control information so that it flows in one direction. Dopamine is closely related with creativity. Personally it is assumed that it will contribute to enhancing learners' creativity by using metacognition.

Orbitofrontal cortex is associated with emotional aspect; particularly with emotional adjustment. Patients impaired with this part express emotional explosion, show inappropriate responses in social relationships, and made dangerous decisions. Yoomin, Learn about Brain and then Teach, Hakjisa, Seoul, 2002.

Thus, it is presumed to serves as adjusting emotional aspect of metacognition.

For instance, metacognition does not function properly so that survival-oriented mechanism starts to work when cortisol is secreted due to negative emotion and excessive threats or stresses are imposed. In contrast, the neurotransmitters that promote people to feel pleasures such as endorphin or dopamine. Therefore, learners will have confidence, happiness, and internal motivation. During this course, they will use metacognition properly and desire to learn enthusiastically. Orbitofrontal cortex is also reported to have close connections with emotional adjustment of metacognition as well as the limbic system.

V. Conclusion

It will be difficult to ascertain what the first language was among oral languages and even more unclear to identify what the first written language was. However, it is easy to give answer whether characters were created at a strike or systematically established through series of trials. It invites us to review how people began to read characters from small marks to mastodon bone ranging between BC 8000 and BC 1000. The underlying story of invisible brain adjustment and change remains in this interesting history.

Brain circuits were rearranged according to more complicated and various conditions required by new characters and individual system, thereby enriching repertoires of human intellectual capacities and reaching the surprising and excellent thinking spring through progressive change.

In particular, the author intends to conclude this paper as Chinese ideograph plays a crucial role in the activation of frontal lobe and by citing the necessity and importance of Hanja education in the age of the upcoming fourth revolution with artificial intelligence.

The activation of frontal lobe and its important role in the highest level of human thinking is discussed in the body, which is likely to provide much-needed helps to overcome recently emerging impulse control disorder and regain self-esteem. As it could be more elaborated from additional studies, the necessity of Hanja education will be more significant if it has practical benefits. The author suggests that Hanja education will be beneficial program in preparations for overcoming humanities crisis and the upcoming artificial intelligence era what is so-called the fourth revolution by emphasizing the urgency of its education and distribution again.

Thanks to extensive interdisciplinary integrated studies including psychology, linguistic psychology, cognitive science, and neural science, this study will make a small contribution in the development and progress of this academic field by inventing educational contents, Hanja, Chinese language, by introducing Chinese educational program, and by addressing the integration of Hanja education and brain science.

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