

## Overview of Neuroplasticity in the Application of the Reverse Whole Brain Model in College Students

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**ABSTRACT:** Modifications applied when using Whole Brain, from the initial application of the left quadrant to the right, to the change from the right quadrant to the left. The formulation of research questions; What is the modified form of the Whole Brain model?, What are the learning outcomes obtained from the use of the modified Whole Brain model? Can the results obtained from the use of modified Whole Brain models be used as tangible evidence of neuroplasticity?. The researcher used a quantitative descriptive design. This design illustrates how the Reverse Whole Brain Model was used based on the respondents. The researcher uses a questionnaire to collect research data. The questionnaire was developed by the researcher using Slavin's (1995) Theory of Effectiveness. Researchers also used the Trail Making Test as a data collection instrument. TCR (Respondent Achievement Level/*Tingkat Capaian Responden*) was used to analyze the questionnaire data. TMT-A was analyzed using parametric tests, and TMT-B was analyzed using nonparametric tests. The Reverse Whole Brain model is considered effective in teaching and learning. The results show that the application of this model in the Listening and Speaking II class is considered an appropriate learning model. It also concluded that the students experience neuroplasticity.

**KEYWORDS:** Reverse Whole Brain Model, Questionnaire, Trail Making Test, paired sample T-Test, Wilcoxon Signed Rank Test

### INTRODUCTION

The human brain is currently considered an important organ in the human body. This brain regulates the way every organ in the human body works. From this, it can be seen that the brain plays a vital role in the human body. What distinguishes the human brain from other organs of the body is the ability of the brain to be elastic. There are many discussions about the brain's elasticity in development circulating on the internet. This further emphasizes that the brain will always adapt throughout human life itself. Education today is starting to undergo many developments. Many methods or approaches in learning and teaching have begun to develop and circulate today. However, there are still a few learning methods or approaches that dwell on the brain. Currently, conventional methods or those that have been developed only dwell on how to make students or learners not feel bored during the teaching process.

In fact, many studies related to the brain state that the development of cognitive abilities will lead to the growth of intelligence in the student or learner. "Cognitive development itself is one of the most important parts of the student development process" (Simanjuntak & Siregar, 2022). From this article by Simanjuntak & Siregar, it can be seen that cognitive development is very important when it is related to the development process of educators and also related to intelligence itself.

Other research has also shown that developed cognitive abilities have an influence on intelligence and ability. "*Pengaruh perkembangan kemampuan yang mencakup aspek kognitif, afektif dan psikomotorik siswa terhadap hasil belajar matematika karena hasil uji T independent menunjukkan Ha diterima (terdapat pengaruh)*" (Salsabila et al., 2023). Research conducted by Salsabila et al. also shows that, in addition to the development of affective and psychomotor aspects, cognitive aspects that are also developed affect students' knowledge abilities. This is shown by the results of mathematics learning that show development.

Whole Brain Model is a model that can be used in learning and teaching, aiming to activate all parts of the brain in humans. Whole Brain Model in its application, it can stimulate each part of the brain with different approaches. The Multisensory approach is used to activate the neural connections used in processing language. The kinesthetic approach is used to help individuals express themselves.

The visualization approach is used to stimulate the ability to comprehend or visually capture concepts. The interaction approach is used to increase individual motivation and participation in a group. Researchers see that this model can activate every part of the brain. It will feel suitable when applied during teaching and learning as proof of neuroplasticity. However, the authors plan to modify



the model as an adjustment of Shin et al.'s research.

Shi et al. saw that there was no learning between the left brain and the right brain. Good teaching should activate the entire part of the brain, not adjust to the left or right brain learner. A good teacher should be able to develop the abilities of every part of their students' brains (Shin et al., 2022). Shin et al. criticized the Whole Brain model for being too rigid in its application; it must follow all the implementation arrangements of the model.

"Individuals manifest brain dominance through hemispheric lateralization because this neurological process creates preferences regarding processing information and making decisions during cognitive work" (Zela-Payi et al., 2025). The lateralization of the brain hemispheres is used to determine which brain dominance a human is using. This process is related to how the human processes information and when making decisions during the cognitive process.

Whole Brain Model states that every part of the human brain is interconnected and that no one dominates. Zela-Payi et al also think that educational methods that are in accordance with students' cognitive abilities can be used as programs that can maximize intellectual abilities and create better academic results and creative solutions (Zela-Payi et al., 2025).

With the above series of statements, researchers see that the Whole Brain Model, as a model that stimulates each hemisphere of the brain, is considered appropriate as a form of neuroplasticity, but there must be a slight modification to overcome the rigidity that exists in the model.

Modifications applied when using Whole Brain, from the initial application of the left quadrant to the right, to the change from the right quadrant to the left, could be a way that, seen by the authors, can eliminate the rigidity of the implementation of the model and also as a tangible form of neuroplasticity.

The formulation of the research focus above is used to formulate research questions in the writing of this research. The research questions that have been made include:

1. What is the modified form of the Whole Brain model?
2. What are the learning outcomes obtained from the use of the modified Whole Brain model?
3. Can the results obtain from the use of modified Whole Brain models be used as tangible evidence of neuroplasticity?

From the above research questions, the author concludes the design of the research objectives. The objectives of this research include:

1. To find out the modified form of the Whole Brain model
2. To find out the results obtained from teaching using the modification of the Whole Brain model.
3. To find out whether the results obtained from the use of modified Whole Brain models can be used as real evidence of neuroplasticity.

## LITERATURE REVIEW

### Neurolinguistics

Humans are basically when they are born, they have innate language skills. There is also an understanding that children are equipped with the ability to understand language rules. That is what accelerates the language acquisition process so that it can take place quickly and, of course, automatically. "*Teori generatif Noam Chomsky menegaskan adanya Universal Grammar bawaan yang memandu pemerolehan, sementara model koneksionis menekankan pembelajaran melalui jaringan saraf yang terlatih oleh pengulangan*" (T. Wahyuni et al., 2026)

Chomsky's generative theory asserts that there is an innate ability in language in the human brain, which shows that humans can basically understand and master a language. Humans can also learn language through the process of repetition of what has been learned before. This is the understanding of the connectionist model.

Language and speaking are human abilities that are used to communicate. "*Penggunaan bahasa adalah sebuah keterampilan yang membutuhkan pengetahuan*" (Miftahudin et al., 2025). Speaking and speaking is not only about making sounds, but also the ability to understand what has been heard and the knowledge in arranging words into a sentence so that they can respond to what has been received before. These things are among the theories that initiated the emergence of neurolinguistics.

Neurolinguistics is one of the branches of science that studies the mechanisms of the brain. Neurolinguistics is a combination of linguistics and neurological/neurological sciences. "*Neurolinguistik merupakan kajian terapan konsep dan teori linguistic pada neurologi, terutama kasus-kasus gangguan berbahasa*" (Aribowo, 2018). Neurolinguistics is the study or science that applies



concepts and theories based on language and neuroscience, which is used in discussing and solving cases of language disorders that exist in the world today.

"Perkembangan bahasa juga sangat dipengaruhi oleh fungsi neurologis yang kompleks di otak" (Safitri et al., 2025). Neurolinguistics is considered necessary because in understanding how a human can understand one or more languages, it is related to the processes carried out by the unity of systems that occur in the brain. Mastering language is not only related to the process of learning and repetition, but also has to do with the complex processes that take place in the brain. That is also why language and speech disorders are discussed by neurolinguistics.

"Kajian neurolinguistik meyakini adanya pusat perilaku berbahasa pada hemisfer kiri, dengan berbagai bukti dan penemuan neurologi" (N. Wahyuni et al., 2024). Neurolinguistics assumes and believes that the center of occurrence of things related to language and speech is centered on the left brain. This is also corroborated by various evidence that language, speech, and the disorders that occur in this matter occur in the left brain.

The research that strengthens the above are:

- Fikria et al are entitled "Hubungan dan Cara Kerja Bahasa dengan Otak Manusia". "Broca and Wernicke's regions, as well as their connecting nerve pathways, play an important role in the production and understanding of language. Damage to these areas can lead to language disorders such as aphasia, which can interfere with the ability to speak, hear, or understand language." (Fikria et al., 2025).
- Andini et al's research, entitled "Hubungan Otak Dengan Kemampuan Berbahasa Manusia". "The results of this study conclude that the left hemisphere of the brain is involved in relation to language" (Andini et al., 2023).
- Trisnawati's research is titled "Permasalahan Pemerolehan Bahasa Pada Mahasiswa Prodi Pendidikan Bahasa Inggris Stkip-Mb Di Tinjau Dari Aspek Neurolinguistik". "The left hemisphere, in addition to playing a role in speaking language, also plays a role in verbal memory functions" (TRISNAWATI, 2018).
- Wattiheluw & Supriadin's research is titled "Neuro-Linguistic Programming In Language Learning: A Teacher's Perspective." Neuro-Linguistic Programming (NLP), when used in language teaching, in particular speaking, can be more effective and directed" (Wattiheluw & Supriadin, 2025).

## Whole Brain Model

The whole brain was coined by Herrmann in his 1998 article. In the study of De Boer et al., it was stated that with a teacher, it is possible to understand that the use of the whole brain can help increase intelligence in students. "Becoming a whole brain® intelligent lecturer makes fertile soil for cultivating and nourishing intelligence in higher education" (Boer et al., 2015). From the research of De Boer et al., it is stated that the use of the whole brain can increase the types of intelligence. "Ultimately, we claim that activating whole brain® innovation to nourish multiple intelligences is only a particle of the higher education cosmos" (Boer et al., 2015).

Research that discusses the use of the Whole Brain method:

- The research that uses this method is a study conducted by Kirstein and Kunz regarding the use of the Whole Brain Learning Auditing courses for S2 students. Kirstein and Kunz's article is titled "A Whole Brain® Learning Approach To An Undergraduate Auditing Initiative – An Exploratory Study" (Kirstein & Kunz, 2016).

"Individual students have different learning styles, and lecturers can no longer afford to ignore this. Lecturers have a responsibility to accommodate students' different learning styles by including learning style flexibility in the offered learning opportunities" (Kirstein & Kunz, 2016). Students today have their own way of learning, and teachers should be able to understand this phenomenon. Teachers must be able to understand this, including by using flexible learning methods, so that the learning goals can be met.

"It was evident from the analysis that the teaching case study incorporated activities that addressed all four quadrants of the whole brain model and thus matched the predicted pattern for learning style flexibility. It can therefore be concluded that the incorporation of learning style flexibility in accounting education is a "mission accomplished" (Kirstein & Kunz, 2016).

By using the Whole Brain Model, it can accommodate the flexibility of learning styles owned by each student. Thus, the research conducted by Kirstein and Kunz on the use of the Whole Brain Model as something that can bridge the flexibility of learning styles owned by every student in the class.

- Next research that is used the Whole Brain Model titled "The Effects of 4MAT Teaching Model and Whole Brain Model on



Academic Achievement in Science” (Tezcan & Güvenç, 2017) done by Tezcan and Güvenç.

Tezcan and Güvenç use the Whole Brain Model as one of the methods for achieving academic achievement in learning. The results of the research stated that "it was found that the 4MAT Teaching Model was more effective than the Whole Brain Model in terms of increasing academic achievement.

It was determined that the effects of the 4MAT Teaching Model and Whole Brain Model on the academic achievement in science did not differ from the effect of inquiry-based instruction. It was also detected that the effects of the 4MAT Teaching Model and of Whole Brain Model on academic achievement in science did not differentiate regarding learning styles of the student.” (Tezcan & Güvenç, 2017).

The use of the 4MAT teaching method appears to be more effective in improving academic achievement. But when compared to teaching methods, inquiry-based instruction, the results obtained from the combination of teaching methods, the MAT Teaching Model, and the Whole Brain Model, are no different, no matter how much the student learns.

- In the study of Hughes et al. (Hughes et al., 2016) entitled "In Pursuit Of A ‘Whole Brain’ Approach To Undergraduate Teaching: Implications Of The Herrmann Brain Dominance Model” mentioning how we should learn and also about teaching methods that are actually in harmony or in accordance with various existing learning methods.

Hughes et al conclude that "We conclude that a ‘whole-brain’ approach is possible but depends on the strategic design of teaching methods to be incorporated into courses and modules, not simply a random selection of random activities.” (Hughes et al., 2016). This means that the approach uses the Whole Brain Model. It can be used, but everything must also be adjusted to the teaching method, which must also be related to the material being taught and the teaching class.

The use of this randomly will not necessarily give good results. Hughes et al also conclude that "this study allows us to deal with this issue sensitively, and can help educators to learn to be ‘smarter’ in the delivery of their courses and the teaching methods they incorporate. That way, a blend of teaching methods or techniques can still be incorporated to the advantage of all students rather than a select number that are ‘more comfortable’ with an associated method based on their present preferred learning style.” (Hughes et al., 2016).

Which means the use of the Whole Brain Model in teaching and learning can be an option because of the mixed teaching method based on the Whole Brain Model can include the students as a whole, not just a part. The research carried out by Hughes et al can actually be a reference for teaching and learning

- The next research is a study conducted by Estrada et al entitled "The Relation between Learning Styles according to the Whole Brain Model and Emotional Intelligence: A Study of University Students” (Estrada et al., 2019). Discuss the relationship between learning styles based on the Whole Brain Model and emotional intelligence.

“Learning styles based on mixed dominances positively influence the development of emotional intelligence. Learning styles associated with the right hemisphere were also found to have a greater impact on emotional intelligence.” (Estrada et al., 2019).

From the statement of the results of the research by Estrada et al, it can be concluded that the learning style dominated by the mixed use of the Whole Brain Model can increase emotional intelligence. Not only that, but the use of the right brain in learning style can also have a big influence on emotional intelligence.

- Research that has used the concept of Whole Brain is research conducted by Du Toit. Du Toit's research entitled "Using Whole Brain® thinking to inform lecturer identity in family medicine: a position paper” (Du Toit, 2022). It tells about the use of the Whole Brain Thinking to determine whether someone has sufficient qualities to become a lecturer.

As conveyed by Du Toit (Du Toit, 2022). "Quality teaching takes place if the whole brain is involved. Diverse approaches to teaching are needed to increase the overall level of engagement with students and colleagues. Colleagues and students alike have preferences for different modes of thinking. This calls for using different approaches and means to accommodate others. As all four quadrants are present in any group of students, facilitating and assessing learning should make provision for different modes of thinking, irrespective of one’s own.”

From this statement, Du Toit concludes that in the teaching mechanism, to be able to create or provide quality teaching, a lecturer must be able to activate all quadrants in his brain, because quality teaching will be created when all parts of the brain work. This is related to the approach that must be done differently for each child. Likewise, when interacting with colleagues, a good lecturer will be able to take a different approach to each colleague and also to his students.

- Subsequent research using Whole Brain Thinking is a research conducted by Shin et al. The article by Shin et al is titled "Beyond



left and right: learning is a whole-brain process” (Shin et al., 2022). Describe the phenomenon of left-brain and right-brain learners.

Shin et al mentioned that "Each hemisphere indeed shows dominance in processing certain types of cognitive function. 10 However, individual characteristics and learning potentials cannot be categorized into the left or the right brain. Not only is the entire brain required for any type of learning, but also there exist considerable individual differences in the hemispheric specialization of any specific function” (Shin et al., 2022).

Each part of the brain has its own role and processes different forms of cognitive learning. However, in fact, it is not possible for each learner to be divided into left-brain learners and right-brain learners. All individual learners have their own strengths and weaknesses, each learning specific things, and in learning something, all parts of the brain are needed to digest and understand what is being learned.

Usage of the whole brain model, not only is it used as a learning method, but it can also be used to measure a person's addiction to something by measuring the emotional habits that arise from the game's players. "Therefore, the causal model of the relationship between the addiction to online games, brain lateralization, and behavioral regulation of emotion was confirmed based on various fit indices" (Atadokht & Ebadi, 2023).

From the results of the study, it was illustrated that the relationship between online game addiction, brain lateralization, and regulation of emotional behavior was confirmed based on various match indices. A person who is addicted to online games will show obvious from the emotional behavior. Method whole brain It can also be used as a tool in the development of a teacher to become a professional and better teacher.

“What we have found thus far is that caveats in the literature do exist as far as studies on Whole Brain® action research are concerned. No studies on Whole Brain® lecturer identity formation exist. This allows us to construct new meanings of lecturer identity formation and action research and participatory action research – to contribute to the advancement of the professional development of early-career academics in health sciences as a scholarly niche. This is what we are aiming at as a scholarly community of practice” (Du Toit, 2022).

The whole brain model is only limited to helping teaching and learning, which of course, students will be able to better understand the logical, procedural, and kinesthetic aspects, but there is no one related to the teacher himself. Du Toit's research objectives are for lecturer identity formation and action research, as well as participatory action research, and also contribute to the professional development of academics.

The learning and teaching process regarding the whole brain, understand the function of all the quadrants of the brain and how to study them. “Based on our research and by extending the Herrmann (1995) model, a comprehensive whole brain model was designed (Boer et al., 2015). This metaphorical model represents the four different quadrants (A, B, C, and D) Herrmann (1995) identified.

The focus of the A quadrant is on logical, rational, quantitative, and theoretical thinking (What?). B quadrant thinking entails organising and sequential and methodological approaches to execute tasks (How?). The focus of the C quadrant is on emotional, expressive, interpersonal, and kinaesthetic aspects of emotive thinking (Who?). D quadrant thinking is about visual, experimental, simultaneous, and conceptual ways of thinking (Why?)” (Boer et al., 2015).

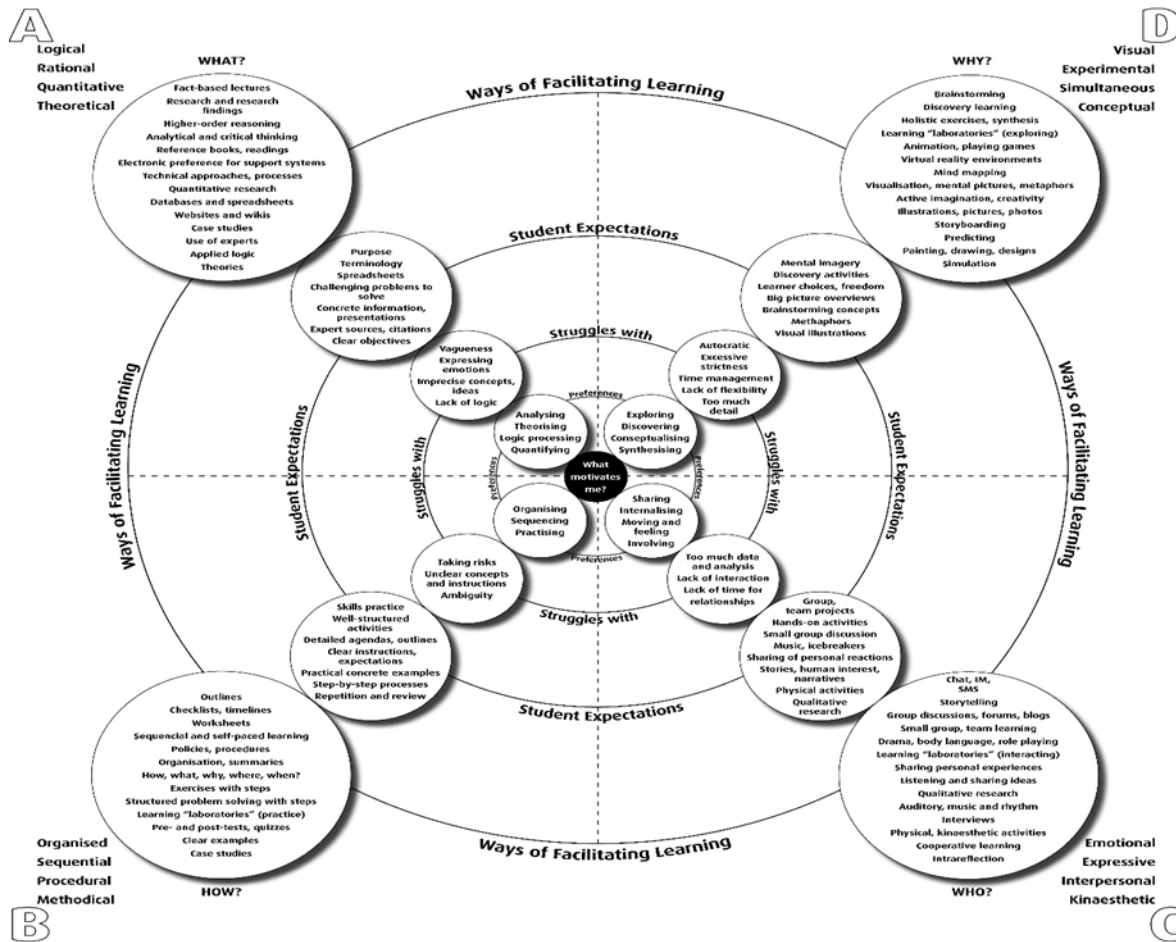


Image 1 Whole Brain model De Boer et al (Boer et al., 2015)

Part A deals with the logic of human thinking, which also deals with calculations or mathematical abilities, and also deals with theoretical ways of thinking, generally related to what questions? Part B deals with the human ability to organize and organize things. This part is also related to the way humans analyze something, which is related to the way or procedure of doing something. Described in the question how?. Part C is the part of the human brain that regulates the emotional side of a person, how to express things. This section also relates to kinesthetics, a person's learning style that involves physical movement, touching, or experiencing an event. Described in the question who?.

Part D deals with a person's ability to visualize things, describing what's on their mind. This part D deals with a person's way of critical thinking and creativity. The depiction of this part D in the form of the question why?. That's why, while a teacher can activate the entire part of his brain in teaching and can teach his students this learning method, De Boer et al. confirm from their research that this learning method can increase intelligence from various aspects: the logical aspect, the procedural aspect, and the kinesthetic aspect.

The Whole Brain model of existing studies is applied to students who do not have a disorder. The Whole Brain is only applied according to the quadrant logic that has been described by Hermann and De Boer. The Whole Brain starts from the left quadrant (A/logic & B/procedure) to the right quadrant (C/emotion & D/visual). Meanwhile, the modifications made by the author to the Whole Brain model start from the right quadrant (C/emotion & D/visual) to the left quadrant (A/logic & B/procedure). The author is not locked into the actual concept of the model but rather modifies.

Neuroplasticity

Elasticity in the brain is currently a hot topic of study and discussion. Neuroplasticity is a neuro-linguistic mechanism for restoring

damage to the brain (Aghaz, 2017). Generally, the understanding of neuroplasticity occurs when people experience damage to their brains. Even though neuroplasticity is not entirely related to this. "*Plastisitas otak merujuk pada kemampuan otak untuk mengubah struktur dan fungsinya sepanjang hidup sebagai respons terhadap pengalaman dan pembelajaran*" (Fahlevi et al., 2023).

The article by Fahlevi et al. mentions that elasticity does not only occur when damage occurs to the brain. Neuroplasticity also occurs when the human brain adapts by changing its shape and function when life experiences occur in the human or when the human learns something. Neuroplasticity, mentioned in the Larasati & Nurdian article, can occur in physical forms or arrangements (functional, young children or adults) and also in the way the brain itself works (functional) (Larasati & Nurdian, 2019).

Larasati & Nurdin, in their article, also mentioned that neuroplasticity occurs not only in adults but can also occur in childhood. Neuroplasticity is also related to the way the brain itself works. The human brain can adapt, and it is also related to how the brain itself works. When the human brain is damaged in one part, other parts will adapt to take over the task of the damaged part of the brain.

In understanding what neuroplasticity means, the author tries to seek knowledge from books about neuroplasticity. Things that are understood as an understanding of Neuroplasticity:

- Adaptation is carried out for life: neuroplasticity is considered a form of adaptation of the human brain. It is believed that this adaptation occurs not only in childhood, but also in the adult brain.
- Main mechanism: when a person learns something new, there is a strengthening of connections in the nerves associated with the novelty and a cutting of synapses (disconnections) in the nerves that are rarely used.
- Response to injury: when one part of the brain is damaged, another part of the brain takes over that function. Example: in people who have had a stroke.
- Effects of experience: brain anatomy is formed from learning, experiences related to emotions, and physical exercise experienced constantly.
- The good and bad possibilities that can happen: neuroplasticity can be something that has a good impact on the human being and their brain (understanding and learning something new). However, it can also harm humans (becoming dependent) (Puderbaugh & Emmady, 2023).

From the things mentioned above, it can be concluded that the brain can be elastic through neuroplasticity associated with the adaptation of the brain itself, the mechanism of the way the brain works, the response to the injury experienced by the brain, the effects of what has been experienced by the human being, and also the existence of good and bad possibilities for the occurrence of neuroplasticity

## METHODS

In this study, the researcher used a quantitative descriptive design. "The quantitative descriptive research method was carried out in this study to find a picture of a situation in an environment or area" (Slater & Hasson, 2025). Slater & Hasson stated that a descriptive research design is used to find a picture of a situation in an environment or condition. The researcher chose this design to illustrate how the Reverse Whole Brain Model was used based on the respondents. Do they benefit from the method or vice versa?

"Population means the definition that should reflect such an attribute like demographic variables, geographic location, and every other feature which could be relevant for research" (Ahmed, 2024). "The sample must therefore be representative of the population" (Andrade, 2020). A population is an overall picture of a group based on its demographics, location, and parts that are representative and relevant to the study.

Samples are representative of the population itself. A sample is a group that is representative of the entire intended population. "...accidental sampling, namely the sampling technique based on chance meeting with the researcher" (Ulfitriana et al., 2025). Accidental Sampling Technique was chosen in determining the sample based on the opportunity that the researcher had with the sample from the population. Researcher choose a class, Listening and Speaking II, in college X, because those classes are taught by the researcher.

The details of the number of samples that were the subject of the study are as follows:



**Table 1 Number of research subjects**

Class Name	Gender		Quantity
	Male	Women	
<i>Listening and Speaking II</i>	6	36	42

The researcher uses a questionnaire to collect research data, which will later be processed using the selected analysis method. "The questionnaire that is used in this research is designed to collect geographic data of respondents (origin of the faculty, position in UKI, gender, and age), data on the use of the "UKI HEBAT" tagline, and data that is related in building the character of "HEBAT" or great" (Limbong et al., 2022).

Based on Limbong et al., the questionnaire is used to collect data on each respondent's characteristics and on what they want to research, as described by the respondents. In this case, the picture that the researcher wants to research is how the respondents assess the teaching model that has been used, Reverse Whole Brain.

The questionnaire was developed by the researcher using Slavin's (1995) Theory of Effectiveness. The factors that affect effectiveness are quality (teaching quality), appropriateness (the right level of teaching), incentive (incentive), and time (time) (Slavin, 1995).

The explanations are:

a. Teaching quality, namely: the extent to which the presentation of information or the ability to help students easily learn the material. The indicators of teachers' ability to manage learning are:

- 1.) Achievement of Learning Objectives.
- 2.) Managing core activities.
- 3.) Organize the learning process well.
- 4.) Interaction.
- 5.) Individual Responsibility
- 6.) Application of Positive Discipline

b. The right level of teaching is the extent to which the teacher ensures that students are ready to receive new learning and that they have the necessary skills and knowledge to learn it. The indicators of student activity in the learning process are:

- 1.) Learning Readiness.
- 2.) Teaching Speed
- 3.) Student readiness.
- 4.) Regularity of the Class Atmosphere.
- 5.) Interactive Activities.
- 6.) Adaptive Instruction.
- 7.) Constructive feedback.

c. Incentive is the extent to which the teacher ensures that students are motivated to work on the study tasks and to learn the material presented. Thus, learning becomes effective and provides positive changes to students. The indicators of student response in learning activities are:

- 1.) Providing Positive Reinforcement.
- 2.) Activities.
- 3.) Adaptive Instruction.
- 4.) Interest in the material

d. Time means the extent to which students are given enough time to study the material being taught. The indicators of learning outcomes in learning activities are:

- 1.) Availability of time according to the difficulty level of the material
- 2.) Efficient Transition Time

Learning will run effectively if learning activities are carried out according to the predetermined time.

**Table 2. Questionnaire Forming Instruments**

ASPECT	BEHAVIORAL INDICATORS	ENQUIRY NUMBER		QUANTITY
		FAVOURABLE	UNFAVORABLE	
TEACHING QUALITY (Mutu Pengajaran)	Achievement of Learning Objectives. (Pencapaian Tujuan Pembelajaran)	1	20	2
	Managing core activities. (mengelola kegiatan inti)	2	21	2
	Organize the learning activity process well. (Mengorganisasi proses kegiatan pembelajaran dengan baik)	3	22	2
	Interaction. (Interaksi)	4	23	2
	Individual Responsibility. (Tanggung Jawab Individual)	5	24	2
	The Implementation of Positive Discipline. (Penerapan Disiplin Positif)	6	25	2
THE RIGHT LEVEL OF TEACHING (Tingkat Pengajaran Yang Tepat)	Learning Readiness. (Kesiapan Belajar)	7	26	2
	Teaching Speed. (Kecepatan Pengajaran)	8	27	2
	Student Readiness. (Kesiapan Peserta Didik)	9	28	2
	Regularity of the Classroom Atmosphere. (Keteraturan Suasana Kelas)	10	29	2
	Interactive Activities. (Aktivitas Interaktif)	11	30	2
	Adaptive Teachers. (Pengajar yang Adaptif)	12	31	2
	Constructive Feedback. (Umpan Balik Konstruktif)	13	32	2
INCENTIVE (Insentif)	Providing Positive Reinforcement. (Pemberian Penguatan Positif)	14	33	2
	Activities. (Aktivitas)	15	34	2
	Adaptive Instruction. (Instruksi yang Adaptif)	16	35	2
	Interest in the material. (Ketertarikan pada materi)	17	36	2
TIME (Waktu)	Availability of time according to the difficulty level of the material. (Ketersediaan Waktu Sesuai Tingkat Kesulitan Materi)	18	37	2
	Efficient Transition Time. (Waktu Transisi yang Efisien)	19	38	2

The scale that was used in the questionnaire is the Likert model with 5 alternative answers Strongly Disagree (Sangat Tidak Setuju/STS), Disagree (Tidak Setuju/TS), Neutral (Netral), Agree (Setuju), Strongly Agree (Sangat Setuju).

Table 2. Rating scales in questionnaires

Scale	Favorable	Unfavorable
Strongly Disagree (Sangat Tidak Setuju/STS)	1	5
Disagree (Tidak Setuju/TS)	2	4
Neutral (Netral)	3	3
Agree (Setuju)	4	2
Strongly Agree (Sangat Setuju)	5	1

In addition to questionnaires, researchers also used the Trail Making Test as a data collection instrument. The data from this test was used as a form of validation of whether neuroplasticity occurred or not. There are several measuring instruments that are used as a form of validation that neuroplasticity occurs. One of them that is considered valid is the Trail Making Test. The author chose these two measuring tools as instruments to measure whether or not cognitive improvement occurs.

Trail Making test is a measurement tool in the neuropsychological field used to see the speed of the subject being studied in processing information, visual attention, and mental flexibility (Indonesia, 2025). *Trail Making Test* or TMT is divided into 2 forms, TMT A and TMT B. “TMT-A menilai kemampuan pengalihan perhatian sederhana dan kecepatan visualmotorik, sementara TMT-B menilai kemampuan shifting dan kontrol eksekutif yang lebih kompleks” (Firdaus et al., 2025).

Fellows et al in the article Rafika & Armelia mention that “TMT-A terutama mengukur kemampuan visuospasial. Sebaliknya, TMT-B berhubungan dengan kemampuan kognitif yang lebih kompleks yaitu fungsi eksekutif” (Rafika & Armelia, 2020). TMT A and TMT B are used as two measuring tools to see overall cognitive ability in relation to the speed and control of what is seen, simply measuring the function of the cognition. That’s why in the study, it was stated that TMT is used to measure a person’s cognitive function (Gounari et al., 2025).

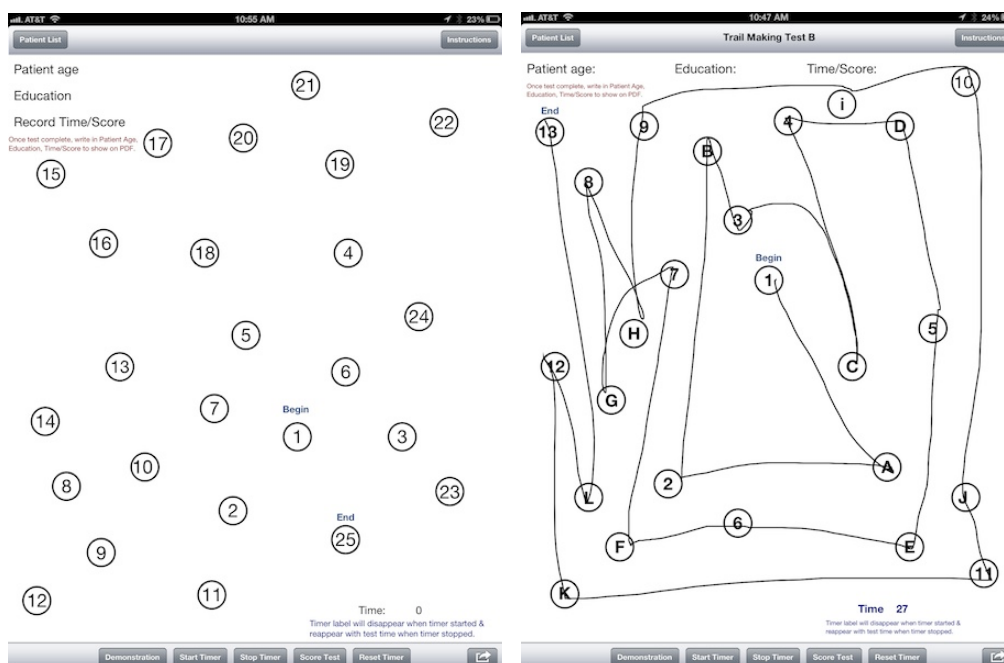


Figure 1 TMT A and TMT B

In this study, the researcher chose to use a quantitative descriptive method, in this case, descriptive statistics. “Descriptive statistics help summarize the variables in a data set to show what is typical for a sample. Measures of central tendency (ie, mean, median, mode), measures of spread (standard deviation), and parameter estimation measures (confidence intervals) may be calculated”

(Kotronoulas et al., 2023). The researcher analyzed the results of respondents' answers to the questionnaire that had been given by looking for the value Mean, median, and mode.

To find the trends that arise from all the answers from the respondents. The researcher also used TCR in the TMT-A and TMT-B test answers. TCR (Respondent Achievement Level/*Tingkat Capaian Responden*) is used to analyze the questionnaire data that has been obtained, and then interpreted based on the score criteria (Nurhaliza et al., 2025).

TCR (Respondent Achievement Level/*Tingkat Capaian Responden*) is used to measure respondents' opinions on the use of the Reverse Whole Brain Model during teaching that has been carried out before. Respondents' answers will be analyzed using percentages, averages, and TCR. The achievement criteria are classified using the assessment criteria as used by Rapiana&S (2024) based on Sugiyono (2019)

Table 3. Criteria for the Respondent Achievement Table (TCR) (Rapiana & S, 2024)

Criteria	TCR
Excellent	90-100
Good	80-89
Enough	70-79
Less good	55-59
Very bad	1-54

**RESULT**

The description of the data from the research is intended to present an overview of the dissemination or distribution of data. The data presented is a score that has been processed from data obtained through questionnaire instruments. The questionnaire was distributed to students of the Listening and Speaking II class at University X. The description is as follows

Description of the research respondents

The description of the research respondents is an overview of the distribution of respondents who are the subject of the study. The subject of this study was a student of the Listening and Speaking II class at University X. The number of respondents who filled out the questionnaire was 42. The respondents' profiles are described as follows

a) Respondent data by gender

The following is a table that describes the respondents as a whole by gender

Table 4. Distribution of respondent data by gender

Gender	Students	Percentage (%)
Male	6	14 %
Women	36	86 %
Quantity	42	100 %

Based on Table 5, it is known that the number of respondents based on gender is 6 people who are male (14%) and 36 people who are female (86%). From this data, it can be presented in a diagram as follows

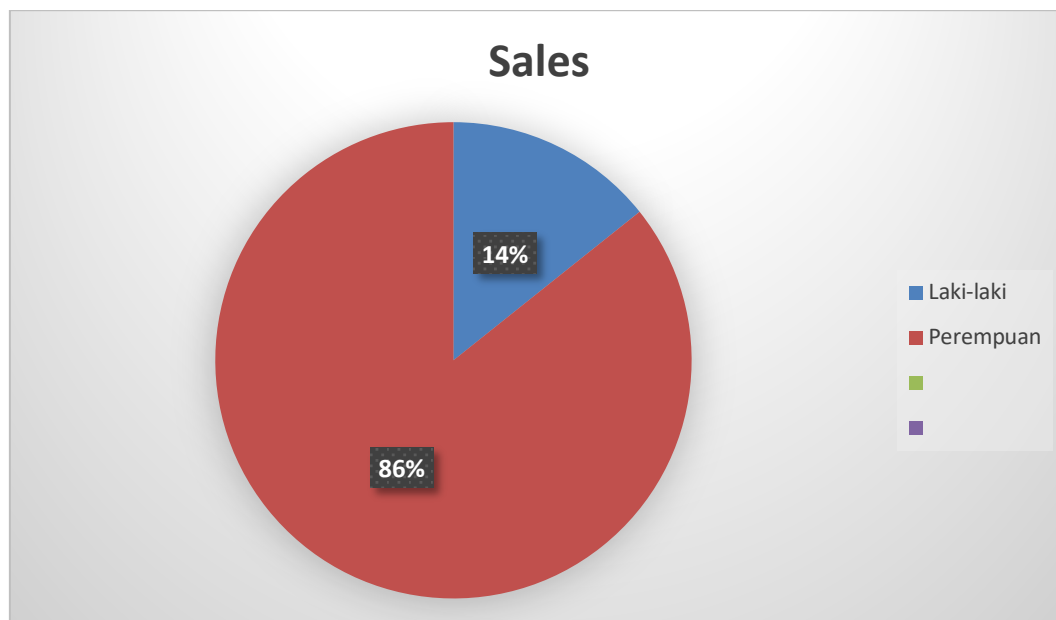


Figure 2 Pie diagram by gender

Based on the diagram above, it can be seen that the number of female students is bigger than the number of male students. It is because the researcher did not control the number of male and female respondents.

b) Respondent data by age

In this section, the researcher recorded the ages of the respondents who filled out the questionnaire. The majority of respondents in this questionnaire are between 14 and 29 years old, as many as 36 students (86%). Only six students are between 30 and 45 years old, as many as 6 students (14%).

Table 5. Distribution of respondent data by age

Age Range	Students	Percentage (%)
14 – 29 years old	36	86 %
30 – 45 years old	6	14 %
46 – 61 years old	0	0 %

Description of research data

The data that has been obtained is intended to provide an overview of the dissemination of data or the distribution of data.

a) Validity of the questionnaire

In testing the validity, the researcher used the Pearson Product-Moment as the validity test. The basis for decision-making, the researcher uses the following:

"A. If  $r$  counts positive and  $r$  counts  $> r$  table, then the variable is valid.

b. If  $r$  calculation is not positive and  $r$  calculation is  $< r$  table, then the variable is invalid" (Nurcahyo & Riskayanto, 2018).

In addition to the use of  $r$  calculation, the researcher also used the Sig. (2-tailed) value as a decision-making, namely:

1. If the value of Sig. 2-tailed  $< 0.05$  and the Pearson Correlation value is positive, then the statement item on the instrument is valid.

2. If the value of Sig. 2-tailed  $< 0.05$  and the Pearson Correlation value is negative, then the statement item on the instrument is invalid.

3. If the value of Sig. 2-tailed  $> 0.05$  and the Pearson Correlation is positive or negative, then the statement item on the instrument is invalid. (Budiantoro & Kurniawan, 2021)



From the calculation with SPSS, it can be concluded that the r value of item 1 calculation is 0.897, while the r value of the table for 42 respondents is 0.304. The basis for the first decision-making, stated in item 1, is valid. Here is the overall result of each item.

Table 6. summary table of the validity test of each statement

NO	rx <sub>xy</sub>	r <sub>table</sub>	Remarks
1	0,897	0,304	Valid
2	0,800	0,304	Valid
3	0,932	0,304	Valid
4	0,870	0,304	Valid
5	0,753	0,304	Valid
6	0,853	0,304	Valid
7	0,842	0,304	Valid
8	0,918	0,304	Valid
9	0,829	0,304	Valid
10	0,908	0,304	Valid
11	0,913	0,304	Valid
12	0,933	0,304	Valid
13	0,898	0,304	Valid
14	0,911	0,304	Valid
15	0,918	0,304	Valid
16	0,903	0,304	Valid
17	0,913	0,304	Valid
18	0,928	0,304	Valid
19	0,885	0,304	Valid
20	0,883	0,304	Valid
21	0,900	0,304	Valid
22	0,927	0,304	Valid
23	0,923	0,304	Valid
24	0,924	0,304	Valid
25	0,868	0,304	Valid
26	0,942	0,304	Valid
27	0,716	0,304	Valid
28	0,911	0,304	Valid
29	0,485	0,304	Valid
30	0,891	0,304	Valid
31	0,951	0,304	Valid
32	0,923	0,304	Valid
33	0,642	0,304	Valid
34	0,898	0,304	Valid
35	0,923	0,304	Valid
36	0,609	0,304	Valid
37	0,880	0,304	Valid
38	0,759	0,304	Valid

Table 7 r-values table

**DISTRIBUSI NILAI r<sub>tabel</sub> SIGNIFIKANSI 5% dan 1%**

N	The Level of Significance		N	The Level of Significance	
	5%	1%		5%	1%
3	0.997	0.999	38	0.320	0.413
4	0.950	0.990	39	0.316	0.408
5	0.878	0.959	40	0.312	0.403
6	0.811	0.917	41	0.308	0.398
7	0.754	0.874	42	0.304	0.393
8	0.707	0.834	43	0.301	0.389
9	0.666	0.798	44	0.297	0.384
10	0.632	0.765	45	0.294	0.380
11	0.602	0.735	46	0.291	0.376
12	0.576	0.708	47	0.288	0.372
13	0.553	0.684	48	0.284	0.368
14	0.532	0.661	49	0.281	0.364
15	0.514	0.641	50	0.279	0.361
16	0.497	0.623	55	0.266	0.345
17	0.482	0.606	60	0.254	0.330
18	0.468	0.590	65	0.244	0.317
19	0.456	0.575	70	0.235	0.306
20	0.444	0.561	75	0.227	0.296
21	0.433	0.549	80	0.220	0.286
22	0.432	0.537	85	0.213	0.278
23	0.413	0.526	90	0.207	0.267
24	0.404	0.515	95	0.202	0.263
25	0.396	0.505	100	0.195	0.256
26	0.388	0.496	125	0.176	0.230
27	0.381	0.487	150	0.159	0.210
28	0.374	0.478	175	0.148	0.194
29	0.367	0.470	200	0.138	0.181
30	0.361	0.463	300	0.113	0.148
31	0.355	0.456	400	0.098	0.128
32	0.349	0.449	500	0.088	0.115

Furthermore, based on the value of sig. (2-tailed). From the calculation with SPSS, the researcher found that the value of sig. (2-tailed) Item 1 is 0.000. Meanwhile, the standard number of social and behavioral sciences used as a comparison is 0.05. From what was obtained, it can be concluded that, in terms of sig. (2-tailed)  $0.000 > 0.05$ , by Pearson Correlation is 0.897.

From what was obtained based on the two bases of decision-making, it can be concluded that item 1 is valid and can be used as a data collection tool. This also applies to items 2 to 38. All statement items in the questionnaire are considered valid and can be used as a data collection tool.

b) Questionnaire reliability

A reliability test is a test used to test an instrument in a questionnaire whether the instrument can be used as a data collection tool and is also reliable. "The meaning of reliability is the consistency of measurement (Mohajan, 2020). According to Quintão et al. (2020), reliability refers to an understanding that instruments used in research to obtain information can be used and trusted as a data collection tool and can reveal accurate information in the field" (Noor & Fuzi, 2025)

Tabel 10. Case Processing Summary

Case Processing Summary

		N	%
Cases	Valid	42	100.0
	Excluded <sup>a</sup>	0	.0
	Total	42	100.0

a. Listwise deletion based on all variables in the procedure.

The table above explains that the respondents who filled out this questionnaire amounted to 42 people. The 100% figure shows that all respondents have filled in all the statement instruments in the questionnaire.

Tabel 11. Reliability Statistics

Reliability Statistics

Cronbach's Alpha	N of Items
.989	38



The table above explains that the statement items in the questionnaire amount to 38 statement items. The value of Cronbach's Alpha obtained from the reliability analysis is 0.989.  $0.989 > 0.60$ , which means that all items in the questionnaire are declared reliable or consistent.

**Tabel 12. Item total statistics**

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Total Correlation	Cronbach's Alpha if Item Deleted
Item_1	164.07	676.897	.888	.989
Item_2	164.36	682.186	.784	.989
Item_3	163.86	676.077	.927	.988
Item_4	163.79	702.319	.864	.989
Item_5	163.86	702.272	.741	.989
Item_6	163.79	702.904	.846	.989
Item_7	163.86	703.443	.835	.989
Item_8	163.93	696.214	.914	.988
Item_9	163.93	691.970	.818	.989
Item_10	164.07	689.775	.902	.988
Item_11	163.86	691.443	.907	.988
Item_12	163.86	695.101	.929	.988
Item_13	163.93	692.556	.892	.988
Item_14	163.93	691.970	.906	.988
Item_15	163.86	695.686	.914	.988
Item_16	164.00	693.073	.898	.988
Item_17	163.86	691.443	.907	.988
Item_18	164.07	684.946	.923	.988
Item_19	163.86	697.003	.879	.989
Item_20	163.86	692.760	.876	.988
Item_21	163.86	696.418	.895	.988
Item_22	163.79	676.270	.921	.988
Item_23	163.71	695.477	.919	.988
Item_24	163.79	695.294	.920	.988
Item_25	163.71	697.672	.862	.989
Item_26	163.71	694.746	.939	.988
Item_27	163.79	707.587	.705	.989
Item_28	163.86	677.394	.903	.988
Item_29	163.93	702.068	.450	.990
Item_30	163.79	696.611	.885	.989
Item_31	163.64	694.918	.948	.988
Item_32	163.71	695.477	.919	.988
Item_33	163.86	703.589	.624	.989
Item_34	163.71	696.502	.892	.988
Item_35	163.71	695.477	.919	.988
Item_36	163.86	700.077	.585	.989



Item_37	163.79	697.051	.874	.989
Item_38	163.79	698.221	.746	.989

c) Description of the questionnaire results data

Data on the use of the Reverse Whole Brain model was obtained from the results of filling in research instruments in the form of an instruction effectiveness scale in teaching, with a total of 38 statements filled in by 42 respondents. From data processing using SPSS version 25, the following results were obtained:

Table 13. description of data statistics

	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance	Skewness	Kurtosis			
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic			
Skor_total	42	88	102	190	7068	168.29	4.174	27.051	731.770	-1.473	.365	1.030	.717
Valid N (listwise)	42												

The mean obtained was 168.29, the range was 88, the variance was 731.770, the maximum score (highest) was 190, the minimum score (lowest) was 102, the Std. Deviation score was 27.051. The effectiveness of the Reverse Whole Brain model is seen from 4 aspects, namely quality, appropriate level of teaching, incentive, and time.

After the calculation of the theoretical mean, the average score and the average score per aspect were calculated. The aspects of the effectiveness of the Reverse Whole Brain model in this study are quality, appropriate level of teaching, incentives, and time.

The average score per aspect describes the average score given by respondents on each aspect of the variable effectiveness of the Reverse Whole Brain model. Meanwhile, the average score describes the average score of the item in each aspect. For the average score, the score range between 1 and 5 corresponds to the weight of the score for the choice of answers on the questionnaire. The following is an overview that has been summarized in the form of a table

Table 14. averages and averages of each aspect

No	Aspects	Average	Rerata	Total
1	End	53	4,416667	Favorable
2	Proper Teaching Level	62,14286	4,438776	Favorable
3	Incentives	35,5	4,4375	Favorable
4	Time	17,64286	4,410714	Favorable

Based on the average score table above, the order of the five aspects is:

Table 15. averages each aspect

No	Aspects	Rerata	Total
1	Proper Teaching Level	4,438776	Favorable
3	Incentives	4,4375	Favorable
3	End	4,416667	Favorable
4	Time	4,410714	Favorable

All aspects have an average score above 2. This shows that most respondents stated that the Reverse Whole Brain model is effective when it is used in their classrooms. After calculating the distribution of data, the average and average score per aspect, the theoretical

mean is calculated.

The theoretical mean of the answer option is 3, so the results of the theoretical mean calculation are obtained as follows: maximum score (number of items x highest score) + minimum score (number of items x lowest score) / 2 = 114.

Table 16. Confidence interval questionnaire

Descriptives

		Statistic	Std. Error
Skor_total	Mean	168.29	4.174
	95% Confidence Interval for Lower Bound	159.86	
	Mean Upper Bound	176.72	
	5% Trimmed Mean	170.76	
	Median	177.50	
	Variance	731.770	
	Std. Deviation	27.051	
	Minimum	102	
	Maximum	190	
	Range	88	
	Interquartile Range	21	
	Skewness	-1.473	.365
	Kurtosis	1.030	.717

From the table above, it can be concluded that the Confidence Interval on the questionnaire of the effectiveness of the Reverse Whole Brain model is in the range of 159.86 to 176.72. Of all respondents who filled out this questionnaire, all respondents are 42 people. 0 people were not defined in this study, because researchers only divided them into two categories, namely high and low.

Table 17. intervals and frequency of filling out questionnaires

Category	Interval Score	Frequency	Prosentase
Height	$X \geq 105$	42	100%
Low	$X \leq 90$	0	0%
Total respond		42	100%

Next, the researcher determined the Respondent Achievement Level (TCR/Total Capaian Responden) obtained from the questionnaire that had been filled out by the respondents.

No	Favorable Statement (English Translation)	Original Statement (Indonesian)	STS (1)	TS (2)	N (3)	S (4)	SS (5)	Total	Total Score	Mean Score	TCR (%)	Category
<b>TEACHING QUALITY (Mutu Pengajaran)</b>												
1	The teaching model used makes me better able to understand the material, both individually and in groups	Model pengajaran yang digunakan membuat saya mampu memahami materi lebih baik, secara individu maupun dalam berkelompok	3	0	6	9	24	42	177	4.2143	84.2857	Good
2	The instructions of this teaching model clearly describe the core activities so that I can understand them	Instruksi model pengajaran ini menjabarkan kegiatan inti dengan jelas sehingga saya dapat memahaminya	3	0	12	9	18	42	165	3.9286	78.5714	Enough



3	In my opinion, the learning process (introduction, core material, Q&A, exercises, and closing) is neatly structured using this teaching model	Menurut saya, proses pembelajaran (pendahuluan, inti materi, tanya jawab, latihan dan penutup) tersusun dengan rapih menggunakan model pengajaran ini	3	0	3	6	30	42	186	4.4286	88.5714	Good
4	This teaching model makes me actively participate during instruction and collaborate with classmates	Model pengajaran ini membuat saya aktif berpartisipasi pada saat pengajaran dan berkolaborasi dengan teman sekelas	0	0	3	15	24	42	189	4.5000	90.0000	Very Good
5	This teaching model makes me feel comfortable interacting with peers both inside and outside the group during learning	Model pengajaran ini membuat saya merasa nyaman berinteraksi dengan teman di dalam kelompok maupun di luar kelompok saat pembelajaran berlangsung	0	0	6	12	24	42	186	4.4286	88.5714	Good
6	The classroom atmosphere becomes comfortable and supportive for individual and group learning with the use of this teaching model	Suasana kelas menjadi nyaman dan mendukung untuk saya belajar secara individu maupun kelompok dengan penggunaan model pengajaran ini	0	0	3	15	24	42	189	4.5000	90.0000	Very Good
<b>RIGHT LEVEL OF TEACHING (Tingkat Pengajaran yang Tepat)</b>												
7	This teaching model helps me understand the material more easily	Model pengajaran ini membantu saya memahami materi dengan lebih mudah	0	0	3	18	21	42	186	4.4286	88.5714	Good
8	This teaching model does not make me feel bored or feel that the instruction is too fast	Model pengajaran ini tidak membuat saya merasa bosan dan atau merasa pengajaran terlalu cepat	0	0	6	15	21	42	183	4.3571	87.1429	Good
9	In my opinion, this teaching model provides adequate initial scaffolding in understanding the material	Menurut saya, model pengajaran ini memberikan umpan awal yang pas dalam memahami materi	3	0	3	12	24	42	180	4.2857	85.7143	Good
10	A conducive learning atmosphere is created for me due to the use of this teaching model	Suasana belajar yang kondusif tercipta untuk saya karena penggunaan model pengajaran ini	3	0	3	18	18	42	174	4.1429	82.8571	Good
11	I feel motivated to participate because of the use of this teaching model	Saya merasa ingin berpartisipasi karena penggunaan model pengajaran ini	0	0	9	6	27	42	186	4.4286	88.5714	Good
12	With this teaching model, the lecturer can adapt to all responses given by me and my classmates	Dengan model pengajaran ini, dosen dapat beradaptasi dengan segala respons yang diberikan oleh saya dan teman-teman sekelas	0	0	6	12	24	42	186	4.4286	88.5714	Good
13	This teaching model makes me want to understand more deeply in each subsequent meeting	Model pengajaran ini membuat saya ingin memahami lebih dalam setiap pertemuan berikutnya	0	0	9	9	24	42	183	4.3571	87.1429	Good

INCENTIVE (Insentif)												
14	The use of this teaching model motivates me in learning and understanding the material	Penggunaan model pengajaran ini membuat saya termotivasi dalam mempelajari dan memahami materi	0	0	9	9	24	42	183	4.3571	87.1429	Good
15	I feel motivated to participate and work earnestly in exercises or assignments because of this teaching model	Saya merasa ingin berpartisipasi dan bersungguh-sungguh dalam menjalankan latihan atau pegasan karena penggunaan model pengajaran ini	0	0	6	12	24	42	186	4.4286	88.5714	Good
16	With this teaching model, I am greatly helped in understanding the material because the lecturer can adapt well	Dengan model pengajaran ini, saya serbanta memahami materi karena dosen dapat beradaptasi dengan baik	0	0	9	12	21	42	180	4.2857	85.7143	Good
17	This teaching model makes me want to understand the material more deeply in each subsequent meeting	Model pengajaran ini membuat saya ingin memahami lebih dalam materi dalam setiap pertemuan berikutnya	0	0	9	6	27	42	186	4.4286	88.5714	Good
TIME (Waktu)												
18	The time available for me to study the material is adequate because of this teaching model	Waktu yang tersedia untuk saya mempelajari materi tersedia dengan tepat karena penggunaan model pengajaran ini	0	3	6	12	21	42	177	4.2143	84.2857	Good
19	Time for me to understand the material is well-managed because the lecturer minimizes wasted time when switching activities	Waktu untuk saya memahami materi tersedia dengan pas karena dosen dapat meminimalasi waktu yang terbuang saat berganti kegiatan	0	0	6	12	24	42	186	4.4286	88.5714	Good

Figure 3 Respondent Achievement Level (TCR/Total Capaian Responden)Favorable Statement Questionnaire

No	Unfavorable Statement (English Translation)	Original Statement (Indonesian)	SS (1)	S (2)	N (3)	TS (4)	STS (5)	Total	Total Score	Mean Score	TCR (%)	Category
TEACHING QUALITY (Mutu Pengajaran)												
20	This teaching model makes me unable to understand the material well, either individually or in groups	Model pengajaran yang digunakan membuat saya tidak mampu memahami materi baik secara individu maupun kelompok	0	0	9	6	27	42	186	4.4286	88.5714	Good
21	The inaccuracy in managing core learning activities is not conveyed appropriately through this teaching model	Ketidaktepatan pengelolaan inti pembelajaran tidak tersampaikan dengan tepat melalui model ini	0	0	6	12	24	42	186	4.4286	88.5714	Good
22	I cannot understand the instructions of this teaching model. The core activities are not clearly described	Saya tidak dapat memahami instruksi model pengajaran ini. Kegiatan inti tidak terjabarkan dengan jelas	3	0	3	3	33	42	189	4.5000	90.0000	Very Good
23	I become passive because of the use of this teaching model	Saya jadi pasif karena penggunaan model pengajaran ini	0	0	6	6	30	42	192	4.5714	91.4286	Very Good
24	I feel uncomfortable interacting when this	Saya merasa tidak nyaman dalam berinteraksi terjadi	0	0	6	9	27	42	189	4.5000	90.0000	Very Good



	teaching model is used	saat model pengajaran ini digunakan										
25	In my opinion, the classroom atmosphere becomes unpleasant for learning with this teaching model, both individually and in groups	Menurut saya, suasana menjadi tidak menyenangkan untuk belajar dengan penggunaan model pengajaran ini, individu maupun kelompok	0	0	6	6	30	42	192	4.5714	91.4286	Very Good
<b>RIGHT LEVEL OF TEACHING (Tingkat Pengajaran yang Tepat)</b>												
26	This teaching model actually makes it difficult for me to understand the material	Model pengajaran ini ternyata membuat saya sulit memahami materi	0	0	6	6	30	42	192	4.5714	91.4286	Very Good
27	I only feel bored or the teaching pace is too fast when this teaching model is used	Saya hanya merasa bosan dan atau terlalu cepat saat model pengajaran ini digunakan	0	0	3	15	24	42	189	4.5000	90.0000	Very Good
28	I cannot understand the material from the initial scaffolding given when using this teaching model	Saya tidak dapat memahami materi dari umpan awal yang diberikan saat penggunaan model pengajaran ini	3	0	3	6	30	42	186	4.4286	88.5714	Good
29	The learning atmosphere becomes unpleasant for me because of this teaching model	Suasana belajar menjadi tidak menyenangkan untuk saya karena model penggunaan ini	3	0	6	3	30	42	183	4.3571	87.1429	Good
30	I am not attracted to participate because of the use of this teaching model	Saya tidak tertarik untuk ikut serta karena penggunaan model pengajaran ini	0	0	6	9	27	42	189	4.5000	90.0000	Very Good
31	The lecturer feels awkward in responding to me because of this teaching model	Dosen merasa canggung dalam menanggapi respons saya karena model pengajaran ini	0	0	6	3	33	42	195	4.6429	92.8571	Very Good
32	This teaching model does not provide any improvement in my learning interest	Model pengajaran ini tidak memberikan perbaikan minat belajar apapun untuk saya	0	0	6	6	30	42	192	4.5714	91.4286	Very Good
<b>INCENTIVE (Insentif)</b>												
33	My motivation decreases because of the use of this teaching method	Motivasi saya menurun karena penggunaan metode pengajaran ini	0	0	9	6	27	42	186	4.4286	88.5714	Good
34	I am not attracted to participate because of the use of this teaching model	Saya tidak tertarik untuk ikut serta karena penggunaan model pengajaran ini	0	0	6	6	30	42	192	4.5714	91.4286	Very Good
35	I am not helped in understanding the material because the lecturer cannot adapt well using this model	Saya tidak terbantu memahami materi karena dosen tidak dapat beradaptasi dengan baik karena menggunakan model ini	0	0	6	6	30	42	192	4.5714	91.4286	Very Good
36	This teaching model does not provide any improvement in my learning interest	Model pengajaran ini tidak memberikan perbaikan minat belajar apapun untuk saya	0	3	6	3	30	42	186	4.4286	88.5714	Good
<b>TIME (Waktu)</b>												
37	The available time is not sufficient for me because of the use of this teaching	Waktu yang ada tidak mencukupi untuk saya karena penggunaan model	0	0	6	9	27	42	189	4.5000	90.0000	Very Good

	model	pengajaran ini										
38	I do not have enough time to understand the material because the lecturer cannot minimize wasted time when switching activities in this teaching model	Saya tidak memiliki waktu yang cukup dalam memahami materi karena dosen tidak dapat meminimalisir waktu yang terbuang saat perpantian kegiatan pada penggunaan model pengajaran ini	0	0	9	3	30	42	189	4.5000	90.0000	Very Good

Figure 4 Respondent Achievement Level (TCR/Total Capaian Responden) unfavorable statement questionnaire

Based on the Respondent Achievement Level (TCR/Total Capaian Responden) results table, it is known that each statement item has a Respondent Achievement Level (TCR/Total Capaian Responden) score along with its categories. Most of the statements are in the very good category, only statements no. 1, 3, 5, 7 to 19 have a good category in the favorable statements.

In unfavorable statements, statements no. 20, 21, 28, 29, 33, and 36 have good categories. For statement number 2, it is the one that has a sufficient category. The entire Respondent Achievement Level (TCR/Total Capaian Responden) score is calculated on average from the total score of 88.49624, so that it was categorized as "GOOD".

d) TMT-A and TMT-B Results

Before the application of the Reverse Whole Brain model, the researcher provided a pretest first to find out the condition of the students. After the use of the Reverse Whole Brain model, the researcher held a posttest. The test equipment used is TMT-A and TMT-B. The table below shows the results of the TMT-A pretest and posttest

Table 18 TMT-A calculation results (pretest and posttest)

Descriptives

TMT A		Statistic	Std. Error			
TMT A	Pretest Group	Mean	32.42	.884		
		95% Confidence Interval for Mean				
		Lower Bound	30.63			
		Upper Bound	34.20			
		5% Trimmed Mean	32.34			
		Median	32.23			
		Variance	32.804			
		Std. Deviation	5.727			
		Minimum	21			
		Maximum	45			
		Range	24			
		Interquartile Range	8			
		Skewness	.333	.365		
		Kurtosis	-.199	.717		
		Posttest Group	Mean	29.73	1.058	
			95% Confidence Interval for Mean			
			Lower Bound	27.59		
Upper Bound	31.86					
5% Trimmed Mean	29.47					
Median	29.23					
Variance	47.004					
Std. Deviation	6.856					
Minimum	20					
Maximum	44					

Range	24	
Interquartile Range	11	
Skewness	.429	.365
Kurtosis	-.691	.717

The table above is a view of the SPSS output table for TMT-A. In the table, in the pretest group, the minimum score is 21, and the maximum is 45. The difference between the two values (range) is 24. In the posttest group, the minimum score is 21, and the maximum is 44. The difference in the two values (range) is 24.

The table above shows that the TMT-A parameters that describe cognitive, attentional, and visuospatial processing speed decreased in score, from a pretest of 32.42 to 29.73 in the posttest. However, in understanding the duration of the work, there is an increase in the time that is needed to work on it. On the pretest, all students took 32.42 seconds. At the time of the posttest, the average time needed by students dropped to 29.73 seconds.

**Table 19. TMT-B calculation results (pretest and posttest)**

Descriptives

TMT B		Statistic	Std. Error	
TMT B	Pretest group	Mean	75.90	4.866
		95% Confidence Interval for Lower Bound	66.07	
		Mean Upper Bound	85.72	
		5% Trimmed Mean	74.30	
		Median	63.69	
		Variance	994.443	
		Std. Deviation	31.535	
		Minimum	46	
		Maximum	134	
		Range	88	
	Interquartile Range	60		
	Skewness	.926	.365	
	Kurtosis	-.895	.717	
	Posttest group	Mean	69.70	4.866
		95% Confidence Interval for Lower Bound	59.88	
		Mean Upper Bound	79.53	
		5% Trimmed Mean	68.08	
		Median	59.69	
		Variance	994.300	
		Std. Deviation	31.533	
Minimum		41		
Maximum		128		
Range		87		
Interquartile Range	61			
Skewness	.892	.365		
Kurtosis	-.901	.717		

The next table is a view of the SPSS output table for TMT-B. In the table, in the pretest group, the minimum score is 46 and the maximum is 134. The difference in the two values (range) is 88. In the posttest group, the minimum score is 41, and the maximum

is 128. The difference in the two values (range) is 87.

The table above shows that the TMT-B parameters that describe cognitive, attentional, and visuospatial processing speed decreased from 75.90 for the pretest to 69.70 in the posttest. In terms of the duration of doing the work, the time for TMT-B has also decreased. The TMT-B pretest, the average student takes 75.90 seconds, but during the posttest, they only take 69.70 seconds. Furthermore, a normality test is carried out to determine the distribution of data from the pretest and posttest score data obtained.

**Table 20. TMT-A normality tests**

Tests of Normality

	TMT A	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
TMT A	Pretest Group	.156	42	.012	.962	42	.180
	Posttest Group	.095	42	.200*	.949	42	.058

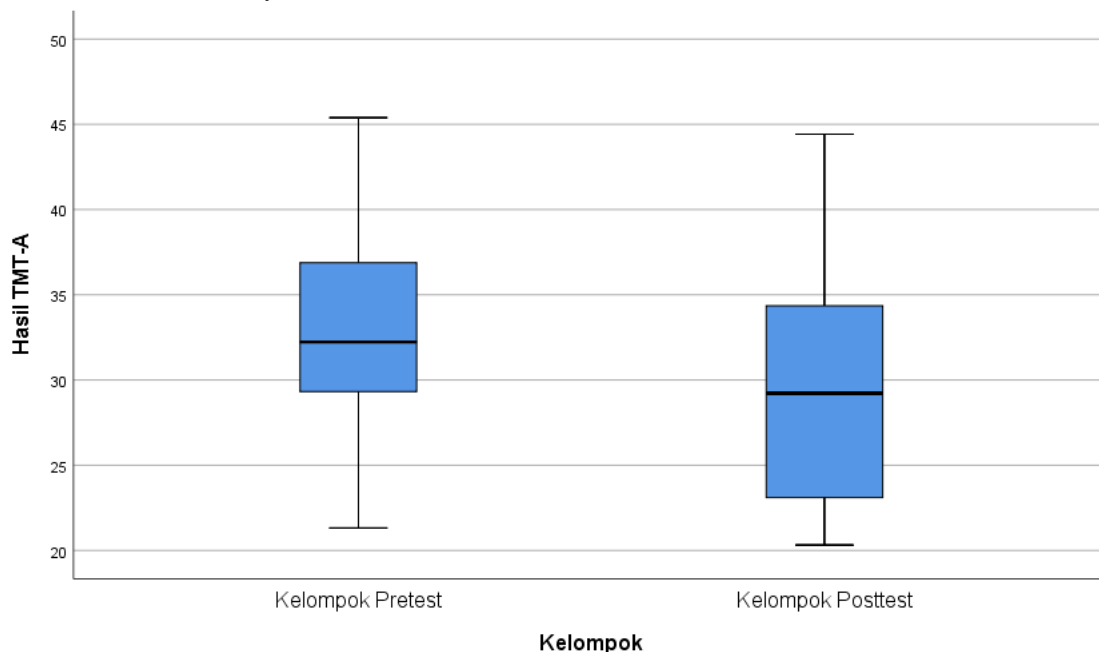
\*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

From the table above, it is known that the df (degrees of freedom) for the TMT-A group is 42. It means the number of respondents who participated in this TMT-A group was less than 50. Because of this, the most suitable one to detect the normality of the data in this TMT-A is Shapiro-Wilk.

In the normality test, the theory on the basis for decision-making in the Shapiro-Wilk normality test, the data is said to be normally distributed (symmetrically) if the Sig. value is greater than 0.05. From the table above, it is known that the Sig. values of this pretest and posttest group are 0.180 and 0.058. The Sig. values for both groups are > 0.05.

Because of this, the basis for decision-making in the Shapiro-Wilk normality test can be concluded that the values in the pretest and posttest groups in TMT-A are normally distributed.



**Figure 5. Distribution of TMT-A normality test scores**

Table 21. TMT-B normality test

Tests of Normality

	TMT B	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
TMT B	Pretest group	.298	42	.000	.764	42	.000
	Posttest group	.283	42	.000	.777	42	.000

a. Lilliefors Significance Correction

From the table above, it is known that the df (degrees of freedom) for the TMT-B group is 42. It means the number of respondents who participated in the TMT-B group was less than 50. Because of this, the most suitable one to detect the normality of data in TMT-B is Shapiro-Wilk. From the table above, it is known that the Sig. values of the pretest and posttest groups are 0.000 and 0.000.

The Sig. values for both groups are < 0.05. Because of this, the basis for decision-making in the Shapiro-Wilk normality test can be concluded that the values in the pretest and posttest groups of the TMT-B are not normally distributed. Normally distributed data can be analyzed using parametric tests, and non-normally distributed data are analyzed using nonparametric tests.

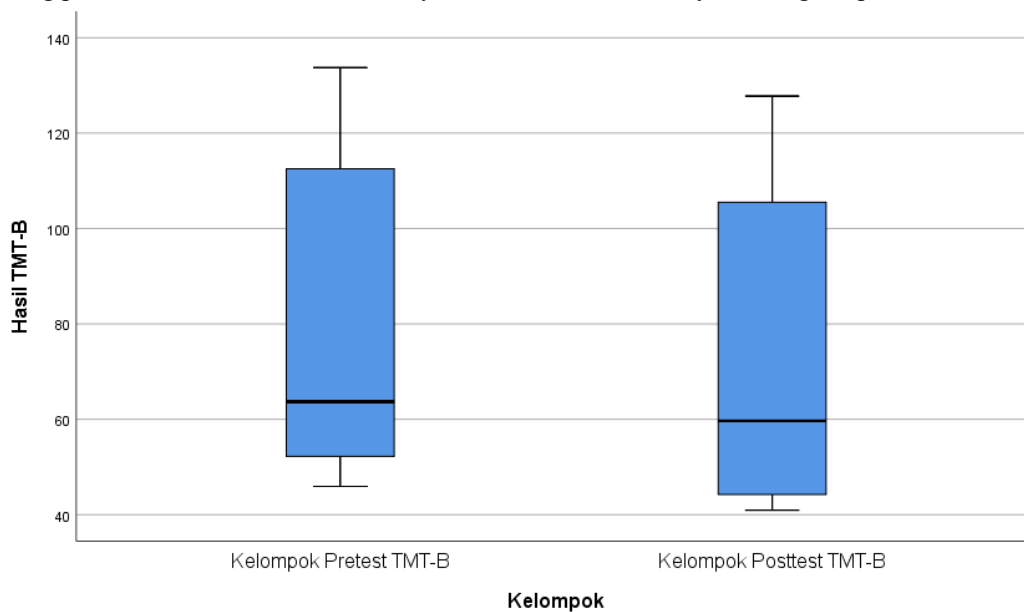


Figure 6. Distribution of TMT-B normality test scores

After the normality test, a homogeneity test is held. This test was held with the intention of finding out whether the data obtained were the same varieties or not.

Table 22. TMT-A homogeneity test results table

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
TMT Value A	Based on Mean	2.276	1	82	.135
	Based on Median	2.238	1	82	.139
	Based on Median and with adjusted df	2.238	1	81.663	.139
	Based on trimmed mean	2.255	1	82	.137

In the output of the table above, it is known that the Sig. Based on the mean value, the TMT-A variable is 0.135. Sig. value  $0.135 > 0.05$ . It can be concluded that the variance of the TMT-A data is homogeneous. It is based on the decision-making guidelines in the homogeneity test. The guidelines are:

1. If the significance value or Sig.  $< 0.05$ , then it can be said that the variance of two or more data population groups is unequal (not homogeneous).
2. If the significance value or Sig.  $> 0.05$ , then it can be said that the variance of two or more data population groups is the same (homogeneous)

**Table 23. TMT-B homogeneity test results table**

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
TMT Value B	Based on Mean	.004	1	82	.947
	Based on Median	.012	1	82	.912
	Based on Median and with adjusted df	.012	1	81.613	.912
	Based on trimmed mean	.004	1	82	.948

In the output of the TMT-B table, it is known that the Sig. Based on the Mean value is 0.947. Sig. value  $0.947 > 0.05$ . From this, it can be concluded that the variance of the TMT-B result value data is homogeneous. It is based on the decision-making guidelines in the homogeneity test.

The next test is the paired sample T-Test for TMT-A. The paired sample T-Test that was used on TMT-A is due to the normal distribution of data on TMT-A. This test is used to compare the average of two paired data groups.

**Table 24. results of TMT-A statistical paired sample**

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre test	32.42	42	5.727	.884
	Post test	29.73	42	6.856	1.058

In the output of the table above, it shows a descriptive summary of the two samples of the group studied, pretest and posttest on TMT-A. For the pretest value, the mean value that appeared is 32.47. In the posttest score, the average score (mean) that appeared is 29.73. The number of respondents that was used as a sample in this study was 42 people.

For the value of Std. Deviation (standard deviation) in the pretest is 5.727. In the posttest, the Std. Deviation (standard deviation) value is 6.856. Meanwhile, the Std. Error Mean value for the pretest is 0.884. In the posttest, the Std. Error Mean value was 1.058. From the mean value, the pretest is  $32.47 > 29.73$ , which means there is a difference in the average score between the pretest and the posttest. To prove whether the difference is real (significant) or not, the results of the paired sample t-test must be analyzed.

**Table 25. paired sample correlations TMT-A**

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre test & Post test	42	.976	.000

The table above shows the results of the correlation test or relationship between the two datasets, the pretest variable and the posttest variable. From the table above, it was known that the value of the correlation coefficient (Correlations) is 0.976 with a significance value (Sig.) of 0.000. Since the value of Sig.  $0.000 < \text{probability of } 0.05$ , it can be said that there is a correlation between the variables that are connected.

Tabel 26. paired sample test TMT-A

Paired Samples Test

		Paired Differences		95% Confidence Interval of		t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Mean	Errorthe Difference				
Pair 1	Pre test - Post test	2.690	1.767	.273	2.140	3.241	9.870	41	.000

The hypothesis that is used for the paired samples test are:

- H0: There is no average difference between pretest and posttest results. It means that there is no effect of the use of the Reverse Whole Brain model in the TMT-A test
- Ha: There is an average difference between the pretest and posttest results. It means that there is an influence of the use of the Reverse Whole Brain model in increasing the time to work on the TMT-A test

The decision-making guidelines in the paired sample t-test based on the significance value (Sig.) of the SPSS output results are as follows:

- If the value of Sig. (2-tailed) < 0.05, then H0 is rejected, and Ha is accepted
- If the value of Sig. (2-tailed) > 0.05, then H0 is accepted, and Ha is rejected

From the paired samples test table, it is known that the value of Sig. (2-tailed) is 0.000.  $0.000 < 0.05$ , then H0 is rejected, and Ha is accepted. It can be concluded that there is an average difference in pretest and posttest scores. It means that there is an effect of using the Reverse Whole Brain model. It also confirms that there is an occurrence of neuroplasticity in respondents who were taught using the Reverse Whole Brain model.

To reassure, the researcher calculates the t-value. In the table, the value of "Mean Paired Difference" is 2.690. This value shows the difference between the pretest mean and the posttest mean on TMT-A. In addition, there is also a difference between 2,140 and 3,241.

In addition to using a comparison between the significance value (Sig.) and a probability of 0.05. The researcher also used a comparison between the t-value of the calculation and the t-table to confirm the results. The guidelines or basis for decision-making are as follows:

- If the t-value is calculated > t table, then H0 is rejected, and Ha is accepted
- If the t-value is calculated < t table, then H0 is accepted, and Ha is rejected

**Titik Persentase Distribusi t (df = 41 – 80)**

Pr df	0.25	0.10	0.05	0.025	0.01	0.005	0.001
	0.50	0.20	0.10	0.050	0.02	0.010	0.002
41	0.68052	1.30254	1.68288	2.01954	2.42080	2.70118	3.30127
42	0.68038	1.30204	1.68195	2.01808	2.41847	2.69807	3.29595
43	0.68024	1.30155	1.68107	2.01669	2.41625	2.69510	3.29089
44	0.68011	1.30109	1.68023	2.01537	2.41413	2.69228	3.28607
45	0.67998	1.30065	1.67943	2.01410	2.41212	2.68959	3.28148
46	0.67986	1.30023	1.67866	2.01290	2.41019	2.68701	3.27710
47	0.67975	1.29982	1.67793	2.01174	2.40835	2.68456	3.27291
48	0.67964	1.29944	1.67722	2.01063	2.40658	2.68220	3.26891
49	0.67953	1.29907	1.67655	2.00958	2.40489	2.67995	3.26508
50	0.67943	1.29871	1.67591	2.00856	2.40327	2.67779	3.26141
51	0.67933	1.29837	1.67528	2.00758	2.40172	2.67572	3.25789
52	0.67924	1.29805	1.67469	2.00665	2.40022	2.67373	3.25451
53	0.67915	1.29773	1.67412	2.00575	2.39879	2.67182	3.25127
54	0.67906	1.29743	1.67356	2.00488	2.39741	2.66998	3.24815
55	0.67898	1.29713	1.67303	2.00404	2.39608	2.66822	3.24515
56	0.67890	1.29685	1.67252	2.00324	2.39480	2.66651	3.24226
57	0.67882	1.29658	1.67203	2.00247	2.39357	2.66487	3.23948
58	0.67874	1.29632	1.67155	2.00172	2.39238	2.66329	3.23680
59	0.67867	1.29607	1.67109	2.00100	2.39123	2.66176	3.23421
60	0.67860	1.29582	1.67065	2.00030	2.39012	2.66028	3.23171
61	0.67853	1.29558	1.67022	1.99962	2.38905	2.65886	3.22930

Figure 7. Distribution table of t-values

Based on the output table of the "Paired Samples Test" above, the t-value is 9.870. In the distribution table of the t-value, the value df (degree of freedom) and significance value ( $\alpha/2$ ) of 41 is equal to 2.01954. The t-value is calculated as  $9.870 > t$  table 2.01954, which means that the basis for decision-making is that  $H_0$  is rejected, and  $H_a$  is accepted.

There is an average difference between the TMT-A pretest and the TMT-A posttest. It means that there is an influence of the use of the Reverse Whole Brain learning model. The existence of this effect confirms that the results of the pretest and posttest TMT-A show neuroplasticity.

Next, Wilcoxon Signed Rank test was carried out on TMT-B. This was done because the data on TMT-B, pretest scores, and posttest scores are not distributed normally. The Wilcoxon Signed Rank test was performed to compare two paired data groups, but the assumption of normality was not met.

**Table 27. Ranks TMT-B**

Ranks		N	Mean Rank	Sum of Ranks
Posttest TMT-B - Pretest TMT-B	Negative Ranks	42a	21.50	903.00
	Positive Ranks	0b	.00	.00
	Ties	0c		
	Total	42		

- a. Posttest TMT-B < Pretest TMT-B
- b. Posttest TMT-B > Pretest TMT-B
- c. Posttest TMT-B = Pretest TMT-B

Negative Ranks between the pretest and posttest are 42 data. It means that there is a decrease from pretest to posttest scores. This also means that it takes longer time to complete the TMT-B pretest than in the posttest. The mean rank that occurred is 21.50, while the number of positive rankings or Sum of Ranks is 903.00.

Positive ranks between pretest and posttest are 0, it also includes N, Mean Ranks, and Sum of Ranks. This value of 0 indicates no increase from pretest score to posttest score. Ties are the same pretest and posttest scores. The value of the Ties in this table is 0, so it can be said that there is no equal value between the pretest and the posttest.

**Table 28. Wilcoxon Signed Rank Test TMT-B test result**

Test Statistics <sup>a</sup>	
	Posttest TMT-B - Pretest TMT-B
Z	-5.676b
Asymp. Sig. (2-tailed)	.000

- a. Wilcoxon Signed Ranks Test
- b. Based on positive ranks.

The decision-making policy that is used in this Wilcoxon test are:

- If the value of Asymp. Sig. (2-tailed) is smaller than  $< 0.05$ , then  $H_a$  is accepted
- If the value of Asymp. Sig. (2-tailed) is greater than  $> 0.05$ , hence  $H_a$  is rejected

From the output table above, it was known that the value of Asymp. Sig. (2-tailed) is 0.000. Since the value is  $0.000 < 0.05$ , it can be concluded that  $H_a$  is accepted. It means that there is a difference between the pretest and posttest scores of TMT-B. It also means that the use of the Reverse Whole Brain model gives influence in time to complete the tests, pretest and posttest. From this, it can be concluded that the results of TMT-B confirm the existence that influence the results in the pretest and posttest. TMT-B results also show the presence of neuroplasticity

## DISCUSSION

Measuring the effectiveness of a model is a way of determining whether a model is considered effective when it is used or not. At this time, there are more and more teaching models that have emerged. Various teaching models and methods have been created that are expected to provide convenience to the teachers as well as learners. It also includes this Reverse Whole Brain model. The researcher applied this model with the intention could become a new model to use for teaching and learning.

This model focuses on touching the right part of the brain first and then the left part. Touching the brain's visual and emotional parts first, then the brain's methodical and theoretical parts. Which, in terms of what happens in teaching and learning today, generally touch on the theory and methods first and then the practice. "The traditional (content-based) approach failed to benefit learners" (Katawazai, 2021).

The factors raised to determine whether the learning model is effective or not include quality, appropriate level of teaching, incentive, and time. These aspects are aspects of the effectiveness of instruction theory in teaching according to Slavin's theory. Slavin states that effective learning must include the 4 pillars as the main aspect.

According to Slavin, these four aspects are interrelated in ensuring that learning goals can be achieved optimally. From all 42 respondents, the results showed that all respondents gave answers to statements in the questionnaire with a score interval of more than 105. None of the respondents answered with a score below that number.

Based on the average score per aspect in the instrument, the highest is the aspect of the right level of teaching. It can be seen that the Reverse Whole Brain model provides the right way of teaching when used by lecturers. Based on the average score per aspect, the highest score is in the aspect of the right level of teaching.

It shows that the Reverse Whole Brain model, according to the respondents, has provided the right way of teaching according to their expectations. From the existing aspects, no assessment shows negative. It means that the respondents feel the implementation of the Reverse Whole Brain model feels as they expect. It has been well presented by their lecturer, and they feel helped in the learning process by applying the model.

Based on TCR (Respondent Achievement Level/*Tingkat Capaian Responden*), the average result shows 88.49624. From this, it can be stated that all statements in the questionnaire are in the "GOOD" category. It can also be concluded that the application of the Reverse Whole Brain model helps in learning English in terms of listening and speaking.

The students who filled out the questionnaire agreed that the Reverse Whole Brain model applied by their lecturers could help them understand the material presented more easily. In the results of the pretest and posttest TMT-A and TMT-B, the average difference score in the pretest and posttest of each TMT-A and TMT-B was obtained.

The results show that the duration required by students in doing the pretest of all TMTs is longer than the duration they needed in doing the posttest of all TMTs. The decrease in the duration of the posttest in TMT-A and TMT-B can be used as a statement that neuroplasticity has occurred in the students who are influenced by the *Reverse Whole Brain model*.

## CONCLUSION

Based on the results of the analyses and discussions in the previous chapter, it can be concluded that the Reverse Whole Brain model is considered effective in teaching and learning. The results show that the application of this model in the Listening and Speaking II class is considered by students who were also respondents to the questionnaire as an appropriate learning model when it is used in the classroom. They feel that the model makes it easier for them to understand the learning materials.

Overall, the highest rated aspect is at the right level of teaching, which means that the model is considered appropriate when it is used by their lecturers. The average score of all statements on the questionnaire was in the "GOOD" category, so respondents agreed that the Reverse Whole Brain model could help them understand the material presented more easily.

In the pretest and posttest work of TMT-A and TMT-B, it was found that the duration of doing the pretest decreased compared to the duration of doing the posttest. With this, it can be concluded that the students experience neuroplasticity. The students experience flexibility and growth in their brains, so there is a difference in the duration of doing the TMT-A and TMT-B pretest compared to the TMT-A and TMT-B posttests.

They experienced a decrease in the duration of time needed during posttest work when compared to the pretest in TMT-A and TMT-B. This confirms that the use of the Reverse Whole Brain model provides evidence of neuroplasticity in the brains of students when given learning materials using the Reverse Whole Brain model.

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