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Exploring Brain-based Learning as a Basis for Developing Technology Education Curriculum

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Abstract

Brain-based learning has recently become noticed by many educators. One author suggests that developing an education curriculum for brain-based learning will help students to be more intrinsically motivated to learn, rather than just memorizing information for a short period of time and not being able to retrieve the information later. This type of learning can be explained through twelve principles of brain-based learning, nineteen concepts of education and teaching, and instructional techniques through neuroscience, the structure and function of the human brain. This research considers the wide range of learning styles and brings basic learning needs into focus. It further reveals that brain-based learning is an important consideration in effective technology education curriculum.

Exploring Brain-based Learning as a Basis for Developing Technology Education Curriculum

In today's public education systems there is a need for increased attention on critical thinking for the students that we teach, and focus less on traditional methods such as memorization of long lists. Research shows that students who memorize information for tests are not necessarily learning or retaining that information (Robertson, 1998). Robertson (1998) also states that by developing a new learning system for students to engage in, these methods will then help them lead to less discipline action and more focus on the true purpose of education. By doing this, educators will be able to provide the proper material and create a challenging and encouraging environment for the students to learn in.

Research indicates that many of the same learning tools are being used in the educational system today (Cassily, 1997). Some of these tools, teaching only one learning style, leaving no room in the curriculum for students to interact, and creating a basic atmosphere with no creative intent, haven't been very effective in educating the students (Robertson, 1998). Most students just memorize information to pass the tests in the classroom, but they aren't retaining a working knowledge of the subject being taught. After tests, the information that the students memorize is replaced with new information that had to be memorized for the next test. Is this an efficient way for students to learn? The brain can store and retain a lot of information, but it depends on how the information is being processed. There are two types of inputting information into the brain: short-term memory and long-term memory. When students memorize material for a short period of time, and never reuse or repeat the information, it is only temporarily learned information, otherwise known as short-term memory. Information is only retained in the long-term memory, or stored permanently in your brain when you recite, reuse, regain, and concentrate on the material being taught (Horsley, 1999).

Brain-based learning makes sense in today's educational system. Looking back on education, it brings up the question that many teachers and educators ask themselves: how could traditional theory be conclusive to the new age of education? Gardner's multiple intelligences theory states that there are many different dimensions of intelligence: linguistic, logical/mathematical, spatial, musical, body/kinesthetic, personal, and interpersonal (Lackney, 2002). Lackney (2002) says that this is just one of the many theories of brain-based learning. Another example of a theory of brain-based learning is that heredity, upbringing, and current environmental demands affect different individuals on how they perceive and process information (On Purpose Associates, 2001). When looking at the brain-based learning style, you can see how factual it is compared to theory. It is said that everyone *can* learn; yet the reality is that everyone *does* learn. In order for a student to gain insight into learning, there must be different ways for them to approach it. Research has shown that it is much more justified to teach how someone actually learns over theory (Lackney, 2002). Since everyone has the ability to learn, no race, age or current environmental demands is going to be singled out. Though not all learning takes a conscious effort, learning does come from within. As long as the brain is not prohibited from fulfilling its normal processes, learning will occur (Howard, 2000).

Brain-based learning is more than how someone learns; it is also a method that creates individual learning curriculum based on one curriculum, unit plan or lesson plan. This passes an important question: If every student learns differently, how can we teach each individual separately when there are more than 30 students in a classroom? Knight (2002) researched this question by observing a brain-based learning classroom. It was found that students in this particular classroom were all given the same instructions, but they were able to work according to how they preferred to learn. They worked in small groups and supported each other's learning. There were stations set up according to different styles of learning: drawing, Internet research, and essays, just to name a few. So, though the question may seem difficult to answer, the reality is that there are a variety of measures built into this work (Knight, 2002). It involves change both inside and outside of the classroom. Some measures that go into teaching each student separately are: changing the physical appearance, or environment, examining the beliefs of faculty on such subjects as learning and their students, and asking such questions as, "how can we improve student achievement?".

Literature Review

What is brain-based learning? Brain-based research is a subject of neuroscience (Howard, 2000). There has been more information researched on the brain in the past 10 to 15 years than the rest of recorded history of the brain. The information is leading to new changes in how students learn and how they can use their brain as an individual brain-based computer to help them learn things more easily, faster and better. The findings that have been discovered in the past 10 to 15 years have made a huge impact on education (Dryden, 2002):

1. Each healthy human brain contains a trillion brain cells, including 100 billion active

nerve cells or neurons, and 900 billion other cells that flue, nourish and insulate the active cells.

2. Each of those active cells can grow up to 20 dendrites, to store information like branches on a tree.
3. From very early in life, the infant brain can form these new learning connections at the incredible rate of up to 3 billion a second. Those connections are the first key to brainpower.
4. Each person has four brains in one: an instinctive brain; an emotional brain; a balancing brain; and the highly developed human cortex.
5. The cortex has two sides – your left *academic* brain and your right *creative* brain.
6. Each side is joined by a corpus callosum, which shuttles millions of messages per second between the left and right sides. The more you use both sides together, the easier it is to learn
7. Your brain has many different *intelligence centers* and each of us can develop those *multiple intelligences* to build on natural strengths and strengthen our weaknesses.
8. Each brain operates on at least four separate wavelengths. The wide-awake beta wavelength is the one we use most effectively when using information we already know (like driving a car or speaking a language in which we are fluent). But the alpha wavelength – the wavelength of *relaxed alertness* – is generally better for quickly learning new information.
9. Each one of us is using only a tiny fraction of our brain's potential.

All of these findings in neuroscience are the structure of brain-based learning (On Purpose Associates, 2001). Without neuroscience, you would not be able to understand the human brain and how it learns and thinks (Merzenich, 2002). In other words, you would not have such things as brain-based learning.

In order to understand the meaning of brain-based learning, you must first understand Caine & Caine's (1997) twelve principles that explain what brain-based learning is. The first principle is called *the brain is a parallel processor,* otherwise known as *the brain is a complex adaptive system* (On Purpose Associates, 2001). The main concept of this principle is that thoughts, intuitions, pre-dispositions and emotions operate simultaneously and interact with other modes of information (On Purpose Associates, 2001). The brain is a parallel processor, which means that it can perform many activities at once, such as smelling and tasting. The brain has the capacity to function on many levels and in many ways simultaneously. There are many different styles of learning that go into technology education curriculum, which come to terms with the complex nature of the human learner (Caine & Caine, 1997).

The brain is a social brain and *learning engages the entire physiology* are both known as the second principle (Chekel, 2002). Humans are physiologically programmed and have cycles that have to be respected within our development. The physical health, the amount of sleep and the nutrition of a student will all have affects on the brain. There are a couple important concepts that should not be overlooked. Fatigue will affect the brain's memory and when a student does not get enough sleep one night, he or she will not absorb as much new information the next day. The brain is shaped as it interacts with the environment and interpersonal relationships. A key to this principle is that the brain/mind changes in its response to engagement with others. This should be looked at when developing technology education curriculum, since learning is influenced by the nature of the social relationships within which people find themselves (Caine and Caine, 1997).

Principle three states, *the search for meaning is innate*, meaning that it is survival oriented and humans are naturally programmed to search for meaning (On Purpose Associates, 2001). This is purpose and value driven to answer the basic questions that Caine and Caine (1997) explore: "why am I here?" and "who am I?" The search for meaning ranges from the need to eat and to find safety through the development of sense of identity and relationships, to an exploration of our potential and the quest for transcendence. Making sense of our experiences illustrates the meaning of principle three, which is important to include when developing technology education curriculum. It allows students to have a sense of identity and explore who they are (Caine & Caine, 1997).

Patterning refers to the organization and categorization of information. This statement summarizes the fourth principle of brain-based learning, *the search for meaning occurs through patterning* (Chekel, 2002). Patterning includes schematic maps and categories, both innate and acquired. The brain automatically registers the familiar, while at the same time, searches simultaneously for a response to novel stimuli. The brain is also considered both artist and scientist, attempting to discern and understand patterns as they occur and giving expression to unique and creative patterns of its own. The brain resists having meaningless patterns and isolated or unrelated pieces of information imposed upon it. This principle gives learners an opportunity to create their own patterns of understanding, which can be used with the technology education curriculum (Caine & Caine, 1997). By this, students can remember more by looking at one topic and relating it to all kinds of different topics (Chekel, 2002). It brings different subjects and ideas together, helping the learning process become more meaningful. Patterning is behind all this (Chekel, 2002).

Principle five is *emotions are critical to patterning* (Chekel, 2002). The need for social interaction and self-esteem are influenced by what you learn and organized by emotions and mind-sets involving expectancy, personal biases and prejudices. Emotions are used when color, impact, meaning and thoughts literally shape each other. You can't separate out emotion from cognition; hence, it is an interacting web of factors. In simpler context, everything has some emotion to it. Technology education curriculum can use this as indispensable emotional climate to sound education (Caine & Caine, 1997). Just as communication is important, so are emotions. Emotions are what motivate us to learn (Chekel, 2002). Without emotions, students wouldn't support each other, or act out their social nature.

The sixth principle, *every brain simultaneously perceives and creates parts and wholes*, discusses the hemispheric theory (On Purpose Associates, 2001). Most educators understand this to be the theory of left brain/right brain, which is not exactly how it works. The brain functions as a whole, not in parts. Within a healthy brain, both of the hemispheres interact in every activity, from art and sciences to accounting. The two-brain theory is a metaphor for the simple fact that the brain reduces information into parts and perceives holistically at the same time. This principle illustrates the notion of the brain always working as a whole, simultaneously processing information. This can be used in technology education curriculum by introducing natural *global* projects and ideas from the beginning (Caine & Caine, 1997). Educators can start by teaching what is correct and true, rather than these theories. Since the brain functions as a whole, educators can take out these false theories that *one side functions better than the other*, or that *one side only works at a time*. Educators need to engage both sides of the brain and teach accordingly, allowing students to take this idea and use it (Chekel, 2002).

Principle seven is *Learning involves both focused attention and peripheral perception* (On Purpose Associates, 2001). The basic concept of this principle is that the brain learns from its environment. The brain attracts information, which it is directly aware of, but it also gathers information that lies beyond the immediate focus of attention. Peripheral signals are extremely potent within the brain because everything that goes into the brain is processed, even the unconscious signals, depending on the message that it is receiving from its environment. Educators should pay attention to all facets of the educational environment by creating technology education curriculum with clear communication and focus on sensory response levels (Caine & Caine, 1997). Educators need to pay attention to what they do and say because students take in everything, whether or not they are aware of it. Sensory response levels can vary, depending on what is being taught, as well as how interested the students are in the subject matter being taught. The more interest there is, the more the students retain and remember through their sight, what they hear, and how they perceive what they see and hear (Chekel, 2002).

Looking at principle eight, *learning always involves conscious and unconscious processes*, educators begin to realize that they learn more than they could ever consciously understand (Chekel, 2002). One way of looking at the aspect of consciousness is by being aware that learning is unconscious in the experience and sensory input, which is processed below the level of awareness. This means that learning may not happen in the classroom but may happen hours, weeks or months later. Some information will enter the brain without our awareness and interact on unconscious levels. An important aspect of this principle is that the meaning is not always on the surface and that it often happens in ways that you don't understand. When learning takes place, it becomes both a conscious and unconscious process. The technology education curriculum can be used to help learners make visible what is invisible (Caine & Caine, 1997). By taking what they learn in the classroom, students can actually reuse and retain information by using it outside of the classroom (Chekel, 2002). It is important to challenge the students and give them something to think about so that they take it and use it at home. When educators teach this way, they are making visible what is invisible by teaching them how to learn without them consciously knowing that they are learning.

Principle nine can be stated two ways: *we have at least two types of memory—a spatial memory system and a set of systems for rote learning* and *we have two ways of organizing memory* (On Purpose Associates, 2001). Whatever the case may be, meaningful and meaningless information are organized and stored differently. Meaningless information are details of day to day experiences that you have, whereas meaningful information are types of memory that people used to call learned traits, such as riding a bike. In regards to the spatial memory, as an autobiographical system, this is a system that does not need rehearsal and allows for instant memory of experiences. In the taxon memory, things are learned by rote, meaning you can memorize the information but that doesn't mean that you can use the information. The local memory system makes your experiences create new connections, which allows you to automatically register the information. This system is always operating and is motivated by novelty instead of reward and punishment as in the spatial memory system. Since meaningful and meaningless information are organized and stored differently, the technology education curriculum can help teach the learners how their brains keep material organized without consciously realizing it (Caine & Caine, 1997). This helps them see the difference between memorizing something verses actually learning that same information. Memorizing information doesn't necessarily mean we can use it (Chekel, 2002). It's important for students to see the difference so that they can be aware of how they are using their own brain.

The brain understands and remembers best when facts and skills are embedded in natural spatial memory and *learning is developmental* is the tenth principle (Chekel, 2002). This principle is one of the most potent keys to brain-based learning where the embedding taxon learns by immersing learners in a well-orchestrated, low-threat, life-like, high-challenge learning environment, which will be the solution to learning. The neurons continue to be capable of making new connections throughout life, which is why it is so important to let the brain develop in all the ways that it is capable of doing, especially when considering the technology education curriculum (Caine & Caine, 1997). It is important to respect that there is no limit to growth and the capacities of people to learn more. By doing this, educators and learners can develop their minds to its full potential and capability.

Downshifting because the brain is under perceived threat is one of the many elements to principal eleven, *learning is enhanced by challenge and inhibited by threat* (Chekel, 2002). The brain makes maximum connections and learns optimally when it is appropriately challenged in an environment, which encourages taking risks. If the brain downshifts because of threats, then it becomes less flexible and reverts to primitive attitudes and procedures. Downshifting is related to a sense of helplessness, but if the learner is engaged in learning, the sense of helplessness disappears. It comes down to not putting stress on the learner. So, when creating technology education curriculum, it is good to know that occasional stress is inevitable and should be expected in genuine learning. Educators should create and maintain an atmosphere of relaxed alertness, involving low threat and high challenge (Caine and Caine, 1997). This will help lower the stress of the students and allow them to engage in what is being taught.

Each brain is unique and *every brain is uniquely organized* is principle twelve (On Purpose Associates, 2001). Learners have many things in common, but each learner is very different. These differences are in terms of consequences of genetic endowments and differing experiences and differing environments. These differences are also expressed in each learner's learning styles, differing talents and intelligence. It is important to realize that multiple intelligences are characteristic of what it means to be human (Caine & Caine, 1997). When looking at technology education curriculum, you can take this into consideration and use these differences to allow students to express themselves. For example, those students who have artistic talents might be allowed to share their work with the class. Those students who are shy or reserved might be allowed to speak through journal entries or small group discussions. These are just a few of many encouraging ways to allow the students to express their individuality. Again, this will help students to learn from each other, which can create new ways to improve classroom learning.

The Impact of Brain-Based Learning on Education and the Reward of Neuroscience

In brain-based learning there are three instructional techniques. The first technique is orchestrated immersions, which are the learning environments that fully immerse students in an educational experience. The second technique is relaxed alertness. This is when you try to eliminate fear in learners, while maintaining a highly educational environment. The last instructional technique is active processing. This allows the learner to consolidate and internalize information by actively processing it.

The instructional techniques have an impact on education in three ways. One way is with curriculum (On Purpose Associates, 2001). For the use of curriculum, teachers must base context and design learning around students' interests. The second impact to education is instruction. An educator needs to let students learn in terms of using peripheral learning. The teacher also has to structure learning around real problems to encourage students to learn outside the school building and the classroom. Assessment is the third way that brain-based learning impacts education. As all students are learners, their assessments should allow them to understand their own learning preferences and style in which they gather information (On Purpose Associates, 2001). This way, students can keep track of their own learning process.

Brain-based learning suggests many ideas for education. How the brain functions has a major impact on learning activities, which are the most effective ways of learning. A teacher needs to capitalize on their experiences in the classroom when they are teaching the students (Merzenich, 2002). Three interactive elements are needed for this process. The first process conveys that teachers must immerse learners in complex interactive experiences that are both real and rich, such as students learning a second language in a different culture. Educators must take advantage of the brain's ability to parallel process. The second process entails that students must have personally meaningful challenges. These challenges will stimulate the student's mind to the desired state of alertness. The last process is known as the *active processing of experience*. In order for a student to gain insight into a problem, there must be intensive analysis of the different ways to approach it, and about learning in general.

Some rules of brain-based learning include (Politano, 2000) :

1. People learn best when solving realistic problems
2. Because every brain is different, educators should allow learners to customize their own environment
3. Feedback is best when is comes from reality, rather than from an authority figure
4. The big picture can't be separated from the details
5. The best problem solvers are those that laugh

Educators need to become artists in the way they create and design brain-friendly environments. The best way to learn is not through lecture, but by participation in realistic environments that let learners try new things safely.

Concepts of Education and Teaching

(Based on the Twelve Principles of Brain-based Learning)

There are 19 concepts of education and teaching that are based on Caine & Caine's 12 principles (Jensen, 2000):

1. Education must come to terms with the complex, multifaceted nature of the human learner.
2. The teacher is an orchestrator of learning.
3. Learning is profoundly influenced by the nature of the social relationships within which people find themselves.
4. The learning environment needs to provide stability and familiarity.
5. Provision must be made to satisfy the hunger for novelty, discovery and challenge.
6. Lessons need to be exciting and meaningful and offer students an abundance of choices.
7. Effective education must give learners an opportunity to formulate their own patterns of understanding.
8. The ideal process in learning is to present information in a way that allows the brain to extract patterns rather then attempt to impose them.
9. An appropriate emotional climate is indispensable to sound education.
10. Educators need to make learners use both the left and the right hemispheres; we want whole brain strategies.
11. Educators should pay extensive attention to all facets of the educational environment.
12. Learners interact with each other in rich learning environments.

13. Educators need to organize what they do to facilitate the subsequent unconscious processing of experienced by students.
14. Teaching largely becomes a matter of helping learners make visible what is invisible.
15. Memorization is memorization, not learning.
16. Take the information off the whiteboards and blackboards and make it come alive in the minds of the learners to help them make connections.
17. Create and maintain an atmosphere of relaxed alertness, involving low threat and high challenge.
18. Learners need more stability in the classroom.
19. An important corollary is to appreciate that learners are different and need choices, while ensuring that they are exposed to a multiplicity of inputs.

Curriculum Based Guidelines for Brain-Based Learning

When considering brain-based learning as a tool in curriculum design, there are a couple of things that should be explored. First, each student needs his or her own personal curriculum. This does not mean that you need to adjust your material by tweaking it for each individual. It simply means that the material being taught is created in a way that every level can understand it, as well as grow from it. According to Atakent & Akar (2003), it is better to assign less, yet more complex projects to allow the brain to be challenged. These two instructors of English are just a few of the teachers around the world that are using brain-based learning as their method of teaching their students. Both instructors have explored the brain's biological conditions that allow us to learn (Atakent & Akar, 2003). They have concluded that it is important to stay consistent and use multi-sensory activities when creating curriculum for the class. It is also essential to celebrate learning and even mistakes that go along with learning, along with making the environment of the classroom realistic, fun, clean and filled with posters, students' work, and other fun accessories.

Examining each principle in brain-based learning will open up the viewpoints of teachers in how they have been teaching (Jacobs-Connell, 2000). It will also allow them to see their subject matter through the eyes of their students and not just through their own eyes. In considering brain-based learning, educators need to know that they are not teaching for the subject matter but for the students' experience in their classroom. When they develop technology education curriculum in regards to brain-based learning, they must understand that the twelve principles that they base their curriculum on are the same way both themselves and their students learn. With this, educators should think of ways in which they have developed their learning style and apply it when teaching their students.

With each step in developing their curriculum, unit, or lesson plan, educators should be taking each of the twelve principles of brain-base learning into consideration. As for *the brain is a parallel processor*; teachers must let their students' learning occur at different levels (On Purpose Associates, 2001). Teachers shouldn't feel as if they are making the students do too much; just the opposite is true. The brain has many functions that can operate or be used at many different levels through a wide variety of activities. Many times, teachers lose the main focus of what the students can actually do. Instead, they focus on the hope that the students understand the information that they are teaching.

Many times teachers look for ways to teach their students in a more efficient manner. They should be able to relay that information to our own students just like it was relayed to us, but then they would learn that what they teach will go against principle two, *learning engages the entire physiology* (Chekel, 2002). Many times teachers compare their students to one another, but really, teachers should be thinking about what each student can do for each other.

Teachers should try and help students use their brain as a social brain (Caine & Caine, 1997). It needs to be nurtured, not just for the set up of learning, but also for preparing the student and their brain to be able to function as an engaged learner, an active learner and an interactive learner. As it states in principle two, fatigue will affect the brain's ability to learn if the learner is not receiving eight hours of sleep per night. There will be some factors that teachers cannot control, but they need to start and encourage good behavior of students that are being engaged in learning. Jacobs-Connell (2000) is a teacher who has used brain-based learning techniques in elementary and middle schools, as well as college settings. She suggests that teachers should first understand their own neurological profile, since this could affect the way they teach. Also, teachers should be open to expand their current teaching techniques and curriculum, which will guide them in how they teach their students.

Knowing oneself is a key point of reaching out to explain the simplest, but most complex questions that a student can ask him or her self. Teachers need to be aware of what they are teaching by making it meaningful. This will help the students gain a safety net in finding a relationship with what he or she is learning. When teaching, you can help the students find more potential to absorb information by allowing them to make an experience with learning, rather than trying to teach them through demands and concepts of relevant meaning.

Education is the survival of learning, in which students, as well as teachers, need to grasp the understanding that basic needs must be met before a higher level of critical learning can occur. They need to know that they have a purpose for being at school and they should be confident in knowing who they are, even during the stage of their life where they may not be sure who they are, through all the growth and changes they go through.

For years, the ultimate question has been: *is teaching an art or a science* (Lackney, 2002)*?* In brain-based learning, teaching and learning are both an art and a science. As learning occurs, educators must also teach students to start to understand how the brain works so that they can teach in the same way their brains learn. The fourth principle illustrates information used in a pattern of organized categories of information. Not only is teaching your subject matter important, but also reaching out and applying the knowledge in other areas by connecting them together so students can start using the patterns in learning information (Lackney, 2002). Technology education curriculum can be adjusted to fit both the art and science aspects of learning. This can be done by connecting each lesson to the next, using pictures, sounds, and challenging techniques to allow the students to go beyond the basic learning of a textbook.

Attitude, just like being in the right emotional frame of mind, is everything when making emotional patterns for gaining knowledge. There is emotion in all that you teach and in all the knowledge that your learners are gaining (Chekel, 2002). As a teacher, you must have positive emotion with how you teach and how you prepare technology education curriculum. Also, find emotion in your students, not just inner psyche of emotion, but external emotional aptitude for enhancing learning. Filling the classroom with color and motivation to interact with learning is a must. Any posters and/or realistic application that can be added to the classroom will bring out an emotional draw for learning in the students. Trying to help students undergo a learning tool of social interaction will bring on positive self-esteem that will help influence an organized learning mind-set.

Every student has the most appropriate tool in his or her control: the ability to learn. Many times, teachers base their teachings from myths, such as the left/right brain theory (Politano, 2000). Sometimes the truth will help teachers understand the actual meaning of learning and the process in which the human brain learns. It is important to look at the differences between myths and truth when creating technology education curriculum. As a matter of fact, how can a teacher teach unless he or she knows the truth about how the brain actually learns? The first thing to look at is the idea of the left/right brain. This is just a theory because in truth, the brain learns with the whole brain, not just one side or the other (Howard, 2000). The brain is where the learning starts. When the brain is functioning properly, it uses both the right and left hemispheres in every activity (learning) that happens in the classroom (Jensen, 2000). Educators should teach with the notion of engaging the whole brain when reaching out to the students' true ability to process information simultaneously.

Working from the same standard of what was discussed in the sixth principle, it leads us to principle seven. How the brain processes information is the key ingredient to finding out how educators should teach their students. What some teachers don't know is that each student's brain processes everything that happens in the classroom. They can either use this as an advantage to their teaching or it can be their worst enemy. One of the developments found in teaching is to surround the students with everything in the classroom environment that gives off signals of interactive learning (Cassily, 1997). Educators can use this as a tool that gives their subject matter the cutting edge of the things they do and say.

Sometimes it seems that the students we teach learn more than we think they understand. That is because that is exactly what happens. Students can learn more than they can consciously understand (Politano, 2000). Teachers have to understand how their students learn and base their technology education curriculum accordingly. They should not be discouraged that the students may not be able to relay information back as soon as they receive it. Sometimes, when students take in new information, they find it hard to understand the information. This does not mean that they haven't learned anything. Most students understand the information some time after they were exposed to it (Politano, 2000). The best thing for an educator to do is teach their students assuming that that will understand everything. Once you repeat and reuse the information, the students will eventually understand what they are being taught.

Reaching out to the needs of how the students learn effects the quality that teachers will get out of their students. In order to learn, our brain has to file the information that it receives so that it can retain the information. Memory comes in two forms in which our students recall information. One way that information can be recalled is instantly, and the other way is by having to learn the information by rote (Chekel, 2002). Learning by rote does not mean that we can use the information in the proper ways as it is attended. Making knowledge of a movement of artistic and scientist notation instead of making it a task will help filter the information to a spatial memory system of gathering information. Putting information in one's brain does not require using reward and punishment to help the student process information, but it is simply done by novelty (Chekel, 2002). Both forms of memory should be taken into consideration when forming technology education curriculum. Learning instantly is different than memorization. We can memorize information, but that doesn't mean that we can use the information (Chekel, 2002). Also, learning by rote can be useful for such things like memorizing multiplication tables, but it is important to learn the concept of multiplication first, so that it makes sense and can be used over and over again (Chekel, 2002).

Making learning natural with spin memory into spatial memory is best with an embedded, low-threatened, life-like, and high-challenged learning environment. This will make it unique for students to learn. A teacher should never stop a student's brain from developing in all the ways that the brain is capable of doing (Jensen, 2000). Giving students choices without letting them have options will make students reach out and learn for themselves, instead of feeling that they have to. The brain is the most important tool in any education system (Jensen, 2000). When a teacher doesn't allow it to function in all the ways that it is able to, they are taking away from a student's education. It is the teachers job to create methods for the brain's ability to develop, even if teaching these methods are not the way you, yourself learn.

Keeping the brain under less stress will help the students take more risks, which will lead the brain to down shift (Jensen, 2000). As a teacher, it is key to not put stress on the learner.

Stress allows the students' brains to become less flexible to achieve the information that you, yourself are trying to teach them. When engaging the students in learning, surround them in an environment that is stress-free and geared towards interacting with what they need to learn (Chekel, 2002).

The most important aspect in creating a curriculum of brain-based learning is that each brain is unique and they each organize information in a unique way (Chekel, 2002). Teachers must remember that students are very different, even though they have many things in common. It is important to teach the students in a way that is the same, but keep in mind that they all learn differently.

Conclusion

Brain-based learning is just a new way of teaching. There is not a concrete method of instructional guidelines that a teacher must follow to teach from the brain-based learning principle. Though, neuroscience plays a big part in brain-based learning. The findings on the brain in the last 10 to15 years have made an incredible impact on education (Dryden, 2002). Without neuroscience, there would not be such things as brain-based learning because there wouldn't be the knowledge out there about how the brain actually works. In this guideline of teaching, it gives all the key components to be able to develop your existing curriculum to work from the brain-based learning principle and neuroscience itself.

Research indicates that educators need to understand that brain-based learning is a more complex learning tool at first, but over time it will develop into the most powerful system in teaching their subject matter (On Purpose Associates, 2001). It will allow them to sit back and give them the chance to see their students start to fully understand and comprehend all the information that they are teaching themselves. For years, educators have been saying that it is impossible to teach 30 students differently; but in truth, it is not. No one knew how to teach that way, but with brain-based learning the question can finally be answered.

This method of teaching gives educators the ability to see how students truly learn. For technology teachers, this is a hands-on learning experience for your students to start to learn technological principles of a technical world that they live in. They can finally learn in a way that will better suit their individual learning needs.

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