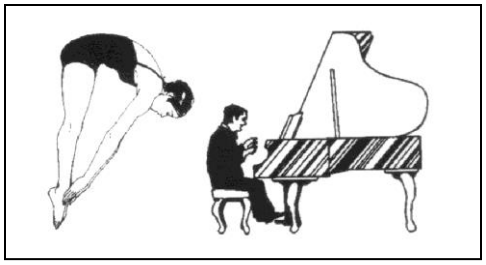

Chapter 3

An Individualized Plan Based on Types of Memory

"The world is run by those who show up. Get involved."
-- A bumper sticker

The first chapter of this book explored how technology is providing (and demanding) for new ways to learn based on control, choice and practice. The second chapter illustrated how certain aspects of the learning environment in high schools could benefit from supplemental technology-based learning. It is now time to specify how an individualized learning-plan utilizing technology could be formulated.

Designers of educational software have long advocated that they have the ability to individualize instruction, but always with limited success. The first most promising application was surely the *tutorial.* It was self-paced and could begin at the point in instruction where each student was ready. But somehow tutorials fell short. They didn't seem to work well for everyone, and their linear quality was undesirable to many.

The next most promised way to individualize instruction was through *distance learning.* The electronic transfer of courses to students wherever and whenever they wanted them seemed like a breakthrough. It could allow any student to receive precisely the instruction they needed when they needed it. Unfortunately, as also noted in the previous chapter, distance learning has its limitations as well. The high degree of initiative and independence required to complete these courses seems to be too much for many students. A high drop-out rate continues to plague the courses.

Since none of the educational technology applications currently available are adequate in themselves for individualized instruction for every student, perhaps, it is time

to consider a different approach. Instead of looking at the technology tools for improving learning, the focus should be on the *learning* itself. Once the critical aspects of learning are identified, a technology tool can then be applied to improve on them. This can make the entire technology integration process much easier because classic learning principles have been around for some time.

These traditional learning principles (and especially adult learning principles), can provide a straightforward way for an individualized program to be designed and implemented. The remainder of this book will explain how educational technology can be aligned with psychological and adult learning principles to improve success for all students in high school and beyond.

Three Types of Memory

As mentioned in the previous chapter, there are three aspects of formal education that could be directly improved from technology in learning – enhanced academic *knowledge*, more real-world and technological *skills,* and increased *motivation*. These three areas of needed learning enhancement, in fact, correspond quite well to the different memory types in the brain.

The cognitive psychologist, Endel Tulving (1927-present), was the first psychologist to determine that there are two separate memory types within long-term memory: *semantic memory* and e*pisodic memory*. An additional memory type, *procedural memory,* was added later by other psychologists for a total of three different memory types[1]. Since learning is really just the process of integrating something into the memory system, building a three-part individualized program based on the three memory types could be an ideal way to structure the plan.

The three memories are located in different brain locations that are neurologically connected to one another. Optimal educational settings should produce learning to *all three* memory types, but this is rarely done. In fact, school learning tends to focus primarily on the first memory type which is *semantic memory* or memory for *knowledge.*

While possessing a strong base of facts and concepts is vitally important, the two other memory types, episodic and procedural memories, are also immensely important. In fact, when *deep knowledge, practical skills,* and *meaningful experiences* are all woven together in relevant ways, information is better understood, retained, and able to be utilized in varied situations. It is now time to examine in more detail each of the three memory types and how they could be a component of an individualized plan.

Semantic Memory

When specific facts and concepts are stored in the brain, it is usually referred to as *knowledge*. Consequently, as students learn, they attempt to integrate new knowledge into the knowledge they already know. As students acquire the new knowledge, their existing neurons become *denser with synapses,* so their knowledge is becoming richer and deeper.

The very prominent child psychologist, Jean Piaget (1896 – 1980), studied extensively the process of semantic (*conceptual)* knowledge acquisition. He speculated that children learn concepts in the world through the processes of *Assimilation* and *Accommodation*. If a child sees a bird and asks, "Is that a bird?", and then hears "yes," the child associates the details of the new bird into her existing concept of a bird. If, on the other hand, the child asks, "Is that a bird?" and then hears, "No, that is a butterfly," the child accommodates her existing concept of a bird to make an entirely new one called butterfly.

But Piaget noted something even more important about the nature of learning conceptual knowledge. He determined that the process seems to change with age. In Piaget's studies, he noticed that students of the same age tended to make similar errors in their thinking (i.e. they thought that clay which had been rolled flat was actually bigger than when it was shaped as a ball). This is really somewhat obvious because everyone knows that a child does not see and understand the world in the same way that an adult does. A child learns and understands the physical world in a way that is more direct and "concrete." An adult, on the other hand, is capable of symbolic thinking and can understand the world based on abstract principles.

Piaget divided the conceptual development of the child into 4 stages: (1) sensori-motor, (2) pre-operational, (3) concrete operational and (4) formal operational[2]. As a child progresses from one stage to the next, the cognitive structures of the preceding stage acts as a foundation for the knowledge to be accumulated in the next stage. Piaget believed that these stages represented a single route of development that *all students follow,* although their progression may be at different rates.

It is important to note that Piaget really downplayed the notion of individual differences. His belief was that progression through the stages was primarily the same but was highly dependent on the student's learning environment. He also made high use of the word *adaptation* to emphasize that students' knowledge mostly builds on knowledge that has adaptive value.

There is pretty substantial evidence across countries and cultures that children do pass through these stages. Given this evidence, there can certainly be strong merit to the argument that a structured and standards rich curriculum can be highly beneficial for younger students to ensure they pass evenly through these stages. However, as Piaget also noted, this may not be the case for adults. Piaget himself had very little to stay about the nature of the last stage of development which is *formal operations.* And even currently, there continues to be much less study and debate on the formal operational stage or even agreement on whether all students actually reach this stage.

Because of the difficulty of clarifying the instructional needs of the formal operational stage, which generally occurs around the high school level, an individualized program using technology may present the best way to address its varied nature. There are two ways that the knowledge structures of older students will vary.

The first way, as noted by Piaget, is the *rate.* Some students will advance more quickly through their academic subjects and will be able to handle more advanced work. Some students, on the other hand, will need additional instruction to keep up. Supplemental learning through an individualized plan can help those students who are progressing at a slower rate as well as those that are moving very rapidly.

The second way that knowledge structures will vary, as Piaget noted, is that the structures will increasingly reflect each student's own "adaptive learning." This means that student's underlying knowledge structures can be quite different depending on their background, culture, learning style and other factors. Since new learning must be integrated with prior learning in order to be retained, assigning some supplemental instruction through an individualized plan according to each student's unique "learner characteristics" can greatly benefit them.

Designing instruction according to learner characteristics is, in fact, a key part of an adult-*andragogic* instructional methodology. An individualized learning program utilizing technology can help meet each student's rate and characteristics. (There is more on concept learning in Chapter 8).

Episodic Memory

It is both formal education *and* day-to-day experiences that contribute to a student's learning events. The outcomes of these "incidental" learning events can frequently alter the course of student achievement and many times for the better. It is true that the most successful people in life are not afraid to try something new – they "get involved."

Providing students with enriching experiences has seldom been a priority of formal education. But when students experience something new, they can get a direct "feel" for it, which may become one of the most powerful learning events they know. A father may allow his son to perform some of his woodworking craft, for example. Through these shared experiences, there can be the very important process of a passing on of a *place for each person* in society so that each member can determine a way to live productively within it.

Episodic memory is memory for personal *experience* and when it occurred. Episodic memories are, in fact, the most vivid memories we have. As most everyone is aware, their memory of *where they were* (space and time) during a significant event, such as the terrorist attacks of 9/11/01, is every bit as clear, or more so, than any factual detail they

remember from the event. (I remember that I was in my car, driving to work, when I first heard about the terrorist attacks.)

One very important aspect of episodic memory that Edwin Tulving noted was that people *remember events chronologically*. As each new experience is remembered, it becomes "stacked" in the front of a chronological organization like index cards in a box. Since this is unlike semantic knowledge which is generally stored in a web-like or networked fashion, episodic memories can be accessed much easier at any time. There is much less reliance on producing an associated memory cue. One only has to think about that time in their life to bring up the memory.

The fact that episodic memory (memory for experience) is actually the *strongest* or "default" memory has a very strong implication for education. The strength of episodic memory implies that people can remember something best when they have *directly experienced* it. For example, I may be told that it is safe to eat red berries; yet in my past, I became ill from eating red berries. My personal experience of becoming ill from eating red berries will be remembered much more clearly and be weighted much more heavily in my decision making to eat red berries than any rule I hear.

Putting personal experiences over all other knowledge seems to be an adaptive quality because directly experiencing something tends to be the most reliable way to know it for certain. Psychologists call this process of weighing experience higher than knowledge as a *Computational Bias*[3].

Of course, educators have long known the benefit of personal experience to the learning process. Many have advocated the importance of field trips for students to attend museums, historical sites, cultural events, etc., so as to directly experience what they are learning. One former teacher, John Taylor Gatto, author of the book, *Weapons of Mass Instruction,* has advocated that experiences should be an essential part of education (i.e. students should visit a courtroom when learning about the law). From his book he wrote:

> Back in the early 1940s, during World War II, I walked through the industrial river town of Monongahela, Pennsylvania several times a week at night, walked miles and miles with my mother, Bootie, and my sister Joanie. … We took the last walk together around 1947. Beginning seven years later and continuing for years

> afterward, I attended five colleges, two of them Ivy League, but my degreed schooling proved to be a waste of time where intellectual development was concerned. I can't seem to recall a single thing I learned at those famous universities, Cornell and Columbia; not a single class, not a single teacher. Yet I remember everything about those walks down to the tiniest details[4].

Learning something through a direct experience or in a sensory way has always been considered beneficial and is especially important for children. Words alone cannot express the richness of a Beethoven symphony, sunset over water, or a peaceful moonlight swim. However, what can most easily be overlooked, and for the majority of people, much of their experiences with the world came from indirect, symbolic methods – through reading, television or movies. After reading a book like *Treasure Island*, a reader can easily feel like they were standing right alongside the pirates during their conquests.

So, although personal experiences are key, and especially for children, as students grow older, they can experience the world in indirect ways. What is experienced through books, computers and media, can be just as effective as direct, hands-on methods. A simulated activity on the computer can provide an enriching experience that is for the most part, every bit as real as an actual event. Through the powerful effects of audio and visuals, students can experience events not always possible to them in other ways.

All sensations and experiences from the environment are, in fact, first filtered through the brain's emotional center, *the Limbic System*. These sensations are then perceived as positive or negative leading them to contain an *emotional* aspect. After acquiring a certain number of positive or negative experiences, people often develop certain *attitudes* about their experiences.

As most people are aware, a deeply felt attitude can result in a more lasting type of learning than any other type. An appreciation for visual arts, for example, may long outlast the specifics of drawing. This is why students need to be exposed to enriching experiences for no other reason than to "open their eyes" to what is possible in the world. They also need to determine if they have a positive feeling for the event. (There is more on experiences in Chapter 9).

Procedural Memory

After accumulating a sufficient amount of knowledge, people can acquire certain *skills* for manipulating this knowledge in productive ways. It has always been the role of formal education to pass on the general knowledge of society to each young person within the society. It has generally not been the role of formal education to pass on the specific skills needed in that society.

Acquiring specific skills had always required a more time focused commitment from the student that usually occurred outside of traditional education. But knowledge is of little value if it cannot be converted into productive uses for society. It is a combination of both knowledge acquisition and skill development that should be a component of a new 21st century learning.

Procedural memory is a collection of all stored actions or skills used in the world. Procedural memory often operates in a fast, automatic fashion. Once a person has learned how to ride a bike, they can "jump on" and confidently ride a bike for the rest of their lives. A certain basis of *semantic knowledge* is required before automatic skill ability can begin. After a foundation of knowledge is acquired, advanced procedural and skill ability comes from continued *practice*.

A piano player will study the keys, cords, and rhythm, and then practice the keyboard fingering movements. Once a level of mastery is reached, piano players no longer have to read music or even look at their hands to guide them. The advanced procedure is in their heads, and it remains there permanently.

Benjamin Bloom (1913 - 1999), a prominent educational psychologist, was the first person to study extensively skill-based learning. He conducted classic experiments on *expert performers*, which included Olympic swimmers, concert pianists, and research mathematicians. He determined that expert performers had similar characteristics. They had: (1) a strong motivation to practice, (2) a strong will to succeed, and (3) the ability to rapidly learn new techniques in their talent field[5].

Repeatedly practicing skills leads to what Bloom called *automacity* – the capacity to perform without conscious attention. Once a skill has been developed to automacity, it

requires frequent use but very little thought to maintain at that level. After achieving an automatic performance, other conscious brain functions can occur during the automatic functions – such as learning something new.

In regards to education, there must be automacity of basic skills before complex learning can be performed, and this only comes from practice. Of course, educators have known this for years, yet focused practice has seldom been emphasized within formal education. Skill learning has tended to be short-term and directly tied to the knowledge from which it is directly related, such as with homework assignments.

Cognitive and Technological Skill Development

Practice has long been emphasized for physical and psycho-motor skill development, but there has been considerably less emphasis of practice for *cognitive and technological skill* development. Yet it is these skills that are increasingly *replacing the physical skills of a trade* to become the needed competencies in today's workplaces.

Cognitive and technological skills are the acquired capabilities that make one able to perform the tasks of daily work and life. These range from operating a piece of machinery to compiling a report. Unlike verbal information, these skills cannot be learned by simply hearing or reading them.

Skill learning requires the *manipulation* of knowledge for a particular purpose. An opportunity to practice cognitive and technological skills in a variety of contexts and in increasing levels of complexity is required in order to strengthen them. Allowing for practice of skills according to a student's chosen area of interest will help the student remain competent in an increasingly competitive labor market.

As most people are aware, there currently exist many skill-development courses like, for example, word processing. Most people also realize that attending a course on word processing does not make a person a highly skilled word processor. Word processing expertise comes from years of practice with the word processing program. Most often this comes from years on the job. It is the continual use of the word processing program for different purposes that make a person a skilled word processor.

When employers hire workers, they look for *education and work experience*. They realize that academic learning does not always prepare a person for the kinds of tasks they must perform on the job. The ultimate question becomes: How can students become prepared for professions that require advanced cognitive and technological skill proficiency when they have not yet had the opportunity to practice or use those skills?

Apprenticeships and internships are one way to expose students to important skills, but other way is through computerized learning. Interactive computer software can provide increasingly difficult and varied practice that will allow students to greatly enhance their skills. It can prepare them for the real world of work by simulating real-world tasks. As Allan Collins and Richard Halverson noted in *Rethinking Education in the Age of Technology:*

> We can imagine a day when most of the training that workers get for their jobs bypasses traditional educational institutions and takes place in online environments. Salespeople might practice their skills with simulations of recalcitrant customers. Doctors might practice their skills by trying to diagnose unusual cases. Future travel agents might be challenged to develop cost-effective trip plans using the web. In fact, almost any job-related skill can be taught by practicing the skill, and computer simulations can create immersive environments where the target skills are necessary for solving engaging problems[6].

The evolving nature of technology requires that individuals continually improve their skills. As the workplace continually changes, people must stay on top of skill development to meet the requirements of the new professions. They must often develop skills before they are able to use them.

An important technological advancement can illustrate this point. After the *Internet* was created, a whole new array of cognitive and technological skills necessity arose in the area of web-page development. A few companies "started up" in order to offer those services, and many businesses had to pay large consulting fees to have their web-sites built. Now web- page development is a skill that many people possess. Those who quickly acquired the skills for web-page development stayed ahead of others and were able to capitalize on those proficiencies.

Benjamin Bloom developed a hierarchy or *taxonomy* of *intellectual skills*, with the intent to illustrate that lower intellectual skills must be mastered before higher-level skills can be acquired. Obtaining intellectual skills means learning *how to do* something in a systematic manner.

The taxonomy has this order: (1) *knowledge* (recalling facts, terms and basic concepts), (2) *Comprehension* (organizing, comparing facts and concepts), (3) *Application* (solving problems, applying techniques and rules), (4) *Analysis* (making inferences and generalizations), (5) *Synthesis* (compiling information in new ways, patterns or solutions), (6) *Evaluation* (critically defending, making judgments, determining validity or quality) [7]. It is easy to recognize how the taxonomy builds from acquiring basic semantic knowledge (facts and concepts) to the complex manipulation of that knowledge (critical thinking and reasoning).

Students need more opportunities to build their intellectual skills from simple to complex. With an individualized plan, students can practice skills at increasing levels of difficulty. There is continued talk within the education community about the need for students to develop "21st century skills". Increasingly in the future, students must have opportunities to practice manipulating knowledge at higher levels of Bloom's Taxonomy and to use this knowledge as applied to complex technologies. (There is more on skill development in Chapter 10.)

The Nature of Intelligence

Since memory consists of "what we know", it is important to touch on the nature of *intelligence.* Does intelligence exist outside of acquired knowledge, or does intelligence grow based on that knowledge? If a student performs well on an achievement test, does this mean that that student is a more intelligent person than someone else, or does it mean that she just learned the material better?

And what about the notion of "Street Smarts?" While some people don't always perform so well in academic settings, they seem to do well in other aspects of life. Since

we are attempting to improve learning through technology, it is important to consider the nature of intelligence so that the technology efforts can be directed in the best way.

The General "g-Factor"

The quest to determine what intelligence really is has been going on for a very long time. In 1927, a psychologist named Charles Spearman proposed that intelligence involves a very high degree of *general ability.* He called this a "g- (general) factor"[8].

After he formulated his term g-factor, intelligence tests were soon constructed to measure this general ability. These tests mostly consisted of items that measured for verbal and mathematical ability, and the tests turned out to be pretty good predictors of academic achievement. But questions always remained on whether the g-factor was the only component of intelligence.

The one definition of intelligence that has seemed to stand the test of time is that "intelligence is what intelligence tests measure." This sounds like a redundant, circular definition, but it does have some validity. It means that if an individual is very successful at tasks considered by society to require intelligence, then tests that reflect those tasks will serve as a measure of intelligence[9]. A definition such as this one implies that intelligence is mostly categorized by *what skills are most desired by society*. Since verbal and mathematical abilities were the ones most prized since the Industrial Revolution, those abilities were deemed to be the most intelligent.

There are two interesting facts about the g-factor. The first fact is that it seems to be getting larger. IQ scores have shown quite substantial gains in the last half-century, and this has occurred in many other countries as well as the United States[10]. If g is a measure of a person's *general* intelligence, how can it be changing and getting larger?

The accepted consensus for this growth is that as intelligent people have more access to enriching learning events, they get even smarter. And it is true that schools are focusing more and more on improving verbal and mathematical abilities in their students so it is really no wonder that these abilities are getting better. But the question posed by

many educators and society at large, and especially in light of the new demands of the information age, is whether these abilities should be the only ones that matter.

Some people, including the Sociologist, Charles Murray, author of *The Bell Curve,* have advocated that students should be measured on their g-factor. Recommendations can then be made for their future path based on the ranking[11]. After all, Murray states, if students do not have high verbal and mathematic ability, is it realistic to expect them to do well in school and especially college?

We would be doing students a disservice if we did not acknowledge that some students will proceed faster and more easily through their academic subjects than others. However, as just stated, intelligence has traditionally been very narrowly defined, and hard work can make up significantly for less native ability. But if students are not performing well (or are interested) in academic subjects, it should be up to them on what they want to do with their future and not others, and especially not based on a test score. By exposing students to a wide range of real-world skills, students can find other ways to become successful.

There is one other very interesting fact about the g-factor. While the g-factor tends to be a reliable predictor of academic success for children, it becomes a less accurate predictor for adults. Testing of the g-factor becomes less reliable as people age, and the very nature of intelligence seems to change as people get older[12]. It seems to be less focused on absorbing completely new knowledge, and instead, becomes more directed to acquiring what is practical to cope with work and life, as the next section will explain.

Fluid vs. Crystallized Intelligence

The psychologist, James M. Cattell (1860-1944), formulated a theory of intelligence that explains how this developmental change in intelligence occurs: fluid vs. crystallized intelligence. *Fluid intelligence* consists of "g", the general factor of intelligence, and includes all of the abilities required for formal education as well as those usually measured on intelligence tests. *Crystallized intelligence,* in contrast, reflects the skills

acquired from both formal education *and from living.* As a person ages, they decline in fluid intelligence, but they gain in crystallized intelligence.

According to Cattell, fluid intelligence tends to peak during adolescence and then declines in adulthood. Crystallized intelligence, on the other hand, continues to increase throughout adulthood. Crystallized intelligence improves as individuals continue to be "information-seeking[13]." That is, they attempt to seek out what knowledge and skills are most beneficial to them.

While children may thrive when learning general knowledge, adults tend to learn best when the learning is more directly targeted to meeting their needs and goals. Educational technology can be an ideal way to bring this real-world and purposeful learning to adults. High school may not be the best time to completely institute an adult-style learning program, but it is good time to start on this path.

Some individualized instruction that is tied directly to a student's desired path for the future can make their learning more relevant. Like a crystal that grows as water pours over it, crystallized intelligence grows when more of the same type of relevant knowledge and skills pour over it.

As Cattell noted, the two types of intelligence are vitally important for meeting societal goals. Fluid intelligence is required for creating a base of learning required for life in society. Crystallized intelligence, on the other hand, is necessary for the acquisition of practical knowledge and skills so a person can perform competently in daily work and life. Targeting learning activities for older learners that better supports their day-to-day situations is a more natural and comfortable way for them to learn.

The Multi-Factor or Aptitudes

Many psychologists, including Howard Gardner of Harvard University, have advocated that people do not have one form of intelligence but more than one – 7 different kinds according to Gardner. Many psychologists, in fact, believe that people do possess different abilities and not just one g-factor. It is true that in adolescence and

adulthood, increasingly it becomes obvious that some students seem to have a *superiority* in certain areas as opposed to others.

One student is a wiz in arithmetic but has difficulty with writing. Another student is a "natural" when working with mechanical devices but is a poor reader. A third student has an "ear" for music but doesn't do especially well in academic subjects. These students are functioning in different ways – mentally. As they continue through life, they will grow farther apart in their ways of thinking and learning.

Although rarely emphasized within academic settings, students should be able to determine their natural abilities or *aptitudes*, so as to make the best choices for a career direction. Discovering aptitudes may be a whole new way to improve learning as the following statement taken from a book about intelligence explains:

> – Intelligence always manifests itself as an interaction between underlying intellectual abilities and experiences in particular domains, and is therefore context/content dependent. [Furthermore,] multiple intelligences exist, and IQ tests measure only a specific type of intelligence, namely one developed in academic settings[14].

In a sense, a student's intelligence is "tested" every day, as they *choose* to participate in certain activities and avoid others. Standardized tests produce an estimate of a student's *general* level of academic achievement, but they generally do little to determine a student's natural abilities.

It is true that some highly intelligent students can have difficulty in the world while some other students who scored lower on intelligence tests end up doing pretty well. These less than academically successful students are able to develop specific competencies that allow them to become productive people. It is a common yet mostly unexplored idea that success in academic learning is far from being a good predictor of success outside the classroom. In this regard, there should be consideration of both *standardized academic achievement* and *real-world abilities*.

Adaptation and "Street-Smarts"

The psychologist, Robert Sternberg (1949 – present), created the term *street-smarts* with the intent to explain the abilities contained in one part of his three-part theory of intelligence: the *practical.* According to Sternberg, the practical part of intelligence is always associated with relevant, real-life situations.

> Practical intelligence is the ability to adapt to everyday life by drawing on existing knowledge and skills. Practical intelligence enables an individual to understand what needs to be done in a specific setting and then do it[15].

What Sternberg is really saying is that a large part of intelligence is the ability to *adapt.* Adaptive learning is rarely emphasized in formal education, but it is becoming increasingly important as the world of work continuously changes. Once students identify their abilities, they will be better able to understand themselves, make the best career choices, and determine ways to direct their abilities as needed. It allows them to find a "goodness of fit" in whatever the environment puts their way.

In this regard, a student can best identify their adaptive abilities when novel situations challenge their capabilities, rather than the mostly routine situations of the classroom. Successful students and successful people in general, are able to find ways to make the most of their strengths *and* compensate for their weaknesses. Providing a diversity of instructional opportunities will allow students to identify their competencies as well as determine how to direct them to the working world in the most beneficial way.

When students recognize and actualize their adaptive capabilities they can develop what has been called *adaptive expertise*[16]. One well known story can illustrate adaptive expertise quite well. It is the epic tale of "Gone with the Wind." In this story, it is Scarlet O'Hara and Rhett Butler who have the most adaptive expertise. They are able to find ways to adapt and even thrive within the chaotic post Civil War South. Other characters in the story are less able to adjust to their new lives and do not achieve as much. Real-world or adaptive ability is a very important component to a successful life.

An Individualized Plan

By noting emerging abilities and interests, teachers (along with students) can design an *individualized plan* that utilizes technology. To take advantage of the brain's three different memory types, the plan should include educational technology applications from three component areas. These three component areas can be tentatively labeled as (1) Academic Knowledge and Skills, (2) Technological and Vocational Skills, and (3) Affective and Experiential Learning.

During Freshman and Sophomore years, students can complete applications during classroom time that directly supplement their academic learning. They can also take some skill-based applications of their own choosing. (Some time will need to be allocated for these self-selected skill-based activities). At the beginning of their Junior year, they should begin to consider if they are more interested in an academic or vocational route.

At this point they can begin to take whole take community college courses and/or distance learning courses in preparation for an academic internship or a vocational apprenticeship during their Senior year.

Academic Knowledge and Skills

Within the *Academic Knowledge and Skills* portion of the individualized plan, there would be assigned to each student a number of applications to directly support their current courses in school. These applications would include remedial programs for slower learners (i.e. tutorials) and advanced applications for faster learners (i.e. mathematical and scientific modeling). These applications would generally not be graded since they would be intended to be supplementary practice to what is learned in class (as tutoring normally is). However, some applications could be noted on grade sheet.

In addition, there should also be a number of "projects" assigned to students. Teachers (and students) should be able to choose which projects they would most like to complete. This will make the projects much more relevant for the students. Projects could

be graded on a complete/incomplete basis, and then added to an e-portfolio. Higher achieving students may do more elaborate projects than lower achieving students.

Technological and Vocational Skills

The second component of the individualized plan is *Technological and Vocational Skills.* Students should be able to take a number of applications in skill-based instruction. This would provide them with the technological and real-world skills that are in demand now in the workplace. All students, including those planning on attending a 4-year university, would take some skill-based applications. These programs could be provided directly by commercial software companies, trade schools, and even private sector businesses (i.e. training software).

For non-academically oriented students, hopefully, these applications can promote an interest and important foot-in-the door for post-secondary education. Technological and vocational applications would be graded through a "performance-based" assessment (as explained in Chapter 7), and they would be noted on the grade sheet.

Affective and Experiential Learning

The last component of an individualized plan would be *Affective and Experiential Learning.* Each student would complete a number of games and media -based applications in the hope that it would promote intrinsic motivation and allow for them to be more directly engaged with their learning. Teachers would assign these programs in order to compliment their curriculum and make it more "meaningful".

Affective and Experiential learning generally would not be graded as these would be used primarily for enjoyment or deep exploratory learning. These applications can be interchanged with the academic applications/projects in order make classroom learning more enjoyable. All students, no matter what their background, can complete them successfully, thus providing some activities not based on ranking or grading.

Key Points to Remember

Piaget determined that semantic (conceptual) memory occurs in developmental stages. The final stage of formal operations is more variable than the other stages. Its characteristics could best be met through an individualized plan.

Episodic memory consists of specific events and when they occurred. It is the most vivid and lasting memory we have. Computers and media can provide ways for students to be better engaged and "open their eyes" to new learning.

Procedural memory is memory for the steps in a process. It requires a base of semantic knowledge, but then procedural memory requires extensive practice to create automaticity. Computers and media can provide practice activities for students to build their cognitive and technological skills from simple to complex.

Individual aptitudes will manifest themselves in early adulthood. By noting each student's strengths (and weaknesses) can allow for supplemental individualized learning. Once students better recognize their abilities, they can develop adaptive expertise that will prepare them for success in the real world.

Children learn through fluid intelligence which is a learning style most conducive for acquiring general academic knowledge. Adults learn through crystallized intelligence which is the ability to integrate new learning with what they already know.