Educational Meta-model and Collaborative Learning

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Key words: *Educational models, cognitive psychology, neurology, evolutionary psychology*

Abstract:

In this paper we present a new meta-model that enables the creation of effective information technology mediated educational programs. This meta-model is based on recent scientific findings in the fields of neurology, cognitive psychology and evolutionary psychology that throw a very strong insight about how e-learning and education in general should be viewed and implemented. Based on such findings, guidelines for the construction of localized educational models are proposed which involve the use of construction, emotion, motivation and technology to improve student satisfaction, real-life transfer of skills and long-time recall of concepts and procedures..

1 Introduction

Whenever an organization, either an enterprise seeking effective employee training or a university aiming to improve its educational processes, engages in the business of delivering knowledge through information technology, it is usually because it sees an opportunity to achieve at least some of the following goals:

1. To widen the reach of the benefits of high quality education and training even to those that by reason of their geographic isolation, their hierarchy in the organization, their family/social situation or they economic constraints cannot have access to it.
2. To eliminate space and time barriers.
3. To reduce costs and thus allow the result of the project to be replicated and thoroughly spread
4. To improve the efficiency of the learning process in such a way that education can take place in a shorter amount of time
5. To improve effectiveness, that is that knowledge and skills acquired by students can easily be translated to real life and thus improve productivity or life quality.

But in order to achieve those goals, an appropriate set of technology tools must be selected and implemented (also called an “Enterprise Information Technology Infrastructure”), educational processes have to be reviewed an adapted to the new technology, teachers, instructional designers, digital contents developers, and on-line tutors must be thoroughly trained. New science such as neurology and evolutionary psychology can give us insight into how the inner mechanisms of the human brain that support learning, teaching and social interaction evolved and actually work. With this knowledge, more effective educational models can serve as a beacon to organizations that will guide their efforts toward a revolutionary and very effective e-learning implementation.

The discussions contained in this paper are a small part of the wealth of information that has arisen as result of the research carried out by the E-LANE project and the National Association of Informatics Education Institutions (ANIEI). In section 2 we briefly discuss the structure of the brain that concern learning. In sections 3, 4, 5 and 6 we discuss the role of motivation, emotion and social interaction as well as the need for a balance approach to education. En section 7 we discuss the Integrated Learning Process Model for Education developed by the ANIEI and E-LANE consortiums.

2 New Science of the Brain

2.1 2.1 Natural Learning

Neuroscience has made many advances in recent years that can be applied to improve teaching and learning. One of the most promising applications of neuroscience to learning is James Zulls "Natural Learning" [1]. Natural Leaning links functional parts of the brain to David Kolbs [2] learning cycle (See Figure 1). Table 1 explains the relation ships between the cerebral cortex and the learning cycle.

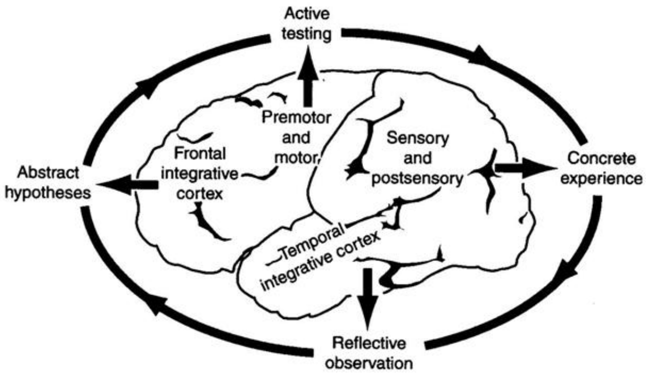

Figure 1. Kolb's Natural Leaning Cycle and the Human Brain

Part of the Cortex	Important Functions	Stage of Learning Cycle	Relation
Sensory Cortex	Receives first input from the outside world in form of vision, hearing, touch, position, smells, and taste	Concrete Experience	Capture of direct physical information from the world
Back Integrative Cortex	Engages in memory formation and reassembly, language comprehension, developing spatial relationships, and identifying objects, faces, and motion. It integrates sensory information to create meaning	Reflection	Remember important information, free association, classification, developing insight and association, and analyzing experiences
Frontal Integrative Cortex	Short term memory storage, problem solving, decision making, assembly of language, making judgments and evaluation, organizing actions, activities and plans, creativity	Abstract Hypothesis	Generation of abstractions (reification), creation of mental schemas, developing plans for future action, comparing and choosing options, creating symbolic representations, and replacing, manipulating items held in short-term memory, and creation of new knowledge
Motor Cortex	Triggers all coordinated and voluntary muscle contractions producing movement, including speech and writing	Active Testing	Action is required for completion of the cycle. Abstractions are tested by executing a plan by converting ideas into action or movement. This includes writing, doing experiments, talking in debate or conversation

Table 1. Relation between different parts of the human brain and Kolb/Zull's natural learning cycle

As Figure 1 and Table 1 show, the natural learning cycle is dead-on in complete concurrence with the structure and function of the brain. When we learn, we usually first perceive the information. This information is integrated to previous knowledge acquired by past experience. We later use the newly acquired knowledge to solve problems, create plans for action to finally act upon such plans and knowledge in such a way that a test of our skills is created. The result of such tests (that is, we either solved or did not solve the problem; and the plan did or did not work) is perceived by our senses and the cycle begins again.

2.2 The Potential of All

We must remember first, that the human brain is an organ for survival. Although genetic inheritance may determine some aspects in the construction of the brain, like number of neurons, ability to create synaptic connections, the numbers of brain cortex convolutions, etc., all human beings have the same blue print not only for brain structure, but for behavior. Humans sense, integrate, abstract and act as a mechanism for survival. Even if we do it differently, this basic cycle is true for all of us, as the new science of evolutionary psychology estates [1,3]. That is to say that, in order to survive, human beings developed highly sophisticated brains that feel two constant urges: **Understanding and control**. As indicated by the natural learning cycle, the purpose of the brain is to establish a mental abstraction of the real world that will enable our body to act; to fight, to run, but mostly to transform, to control. As a weak species that started its existence in this world by being pray, not predators, it became a matter of survival to comprehend the world and control it to our advantage.

3 New Approaches to an Old Factor: Motivation

Thus, one other important aspect of an educational model is the concept of **empowerment**. This means that, by understanding the natural urge that students feel of controlling their environment, the learning cycle will be carefully constructed with the aid of information technology so as to permit students to **take control** and **feel they are in control** of the flow of their learning. That is, to control when, where, how much, and how fast they learn. This control, a focus on student’s **background, culture, interests and environment**, and the realization of how learning will **enhance their life** will motivate students to be active participants in the process.

3.1 The Amygdala and the Basal Structure Control Fear and Pleasure

Apart from cognition and control, human brain filters sensory input through fear and pleasure control centers: The amygdala and the basal structure [1]. People seek what they enjoy and reject what they fear. At all times, as we struggle to make sense of what our senses are detecting, we are constantly confronted with these options: Should I run? Should I fight? Should I attempt to control it? Thus in order to engage learners, education and training should give the brain what it most wants: to obtain important information for survival. In other words, if people see how **learning matters to their lives**, they will find **motivation to learn**. They will engage and do their best effort to learn. Consequently, learning environments should be presented in such a way that they are not perceived as threats or distasteful experiences. If so, students would tend to reject or antagonize those environments. Environments, practices and methods can be made acceptable and desirable to students if they are gently revealed, thoroughly explained and related to student’s previous experiences and if students know for certain that they learn will help them in their lives.

3.2 The Need for Active Learning

There is also biological evidence that regions of the human brain that are related to pleasure are also related to movement. As Zull points out, this is not surprising since movement is needed to achieve happiness and pleasure. This implies that **active learning** must be an integral part of any modern educational model, as much as it should respect the natural learning cycle. But it also implies that convincing students of their achievements we will gain better motivation. Thus education should motivate students using three strategies:

1. Focus on students background, interests, culture and environment
2. Provide active learning
3. Provide achievement based evaluation

As we have learned from the natural learning cycle, action closes this cycle. It allows students to test their ideas and plans. It also allows students to store procedures and algorithms in long-term memory by repetition. This cycle, sense-integrate-act is the reason the nervous system evolved. Every learning technique, philosophy and strategy must follow the cycle: see-mimic-practice, see-discuss-communicate, see-plan-test, think-structure-test, etc. and then repeat. Strategies that emphasize only one o some parts of the cycle, for example when we value speed in mathematical computations and other types of problem solving, or discuss subjects endlessly, will produce much less impressive results. And teachers and instructors must understand that not all can happen fast. Explicitly, there is no time limit for good reflection, which is done in the back-cortex, or good planning which is a front-cortex activity. Emphasis in speed can also be a looser.

Action is not only movement. For the front-cortex action means discussion, argument, debate. When students acquire or raise awareness, take a course of action, commit to ideas, they take action and thus complete the natural learning cycle.

Nevertheless, although active and constant practice will help construct effective knowledge storage and acquisition mechanisms, in order to truly complete the natural learning cycle, students must test their own ideas. A didactical approach based on the natural learning cycle must be an inside-outside, past-future experience. That is to say that advanced didactical approaches should help students learn, reflect, process and integrate knowledge. After that, we proceed from outside-past knowledge managed by the back cortex to inside-future knowledge by making plans, proposing strategies, acting to reach goals, testing in physical or physical-like environments and completing by sensing a complete experience. Either by actually constructing or simulating to construct something, or by sharing, discussing arguing and debate, however we test our ideas the physical nature is always a clarifying process.

It is important to take notice that active testing suggests some form of evaluation. Actually, active testing means the process of confronting one’s ideas against reality. It is the process which is important not actually the result. People love their ideas and even find it hard to incorporate suggestions, let alone severe corrections and concrete right and wrong qualifications. And although evaluation and grading are important and will at the end prove that learning has happened, they should not be carried out before the full learning cycle has been completed.

4 Learning Balance

A traditional teacher will observe that the natural learning cycle in fact supports her method of teaching: explain & demonstrate, followed by drill & practice, followed by problem solving. This time honored practice follows the natural learning cycle. It is not wrong. But it is incomplete. Different studies show that the traditional approach to teaching may be heavily tilted towards the back cortex, which means that learning is passive and may not be translated into efficient plans, strategies and actions [4].

On the other hand, new approaches about education emphasize action based learning, such as problem based learning, project based learning and the like. Those approaches themselves derive from what is called **social constructivism**, which aims to build new knowledge using previous knowledge and constructing upon it through social interactions. Action based learning can tilt learning towards the front cortex, making it much action with little substance [4]. The natural learning process seems to imply that for learning to be effective, some concrete information must be given to the brain in order to start the learning process. All educational models should aims to achieve such a balance that will produce steady increase of understanding and competence and reach deep understanding and complete problem solving skills.

This is achieved by using a balanced approach to learning, where students progress by both using information given didactically, through digital materials and tutoring, and their own experience, which through constructivism provides empowerment to students.

As we explained before, one the main drivers of an educational model should be empowerment. Thus how can we achieve this and estate that students will be driven to consult digital and pedagogical materials? This is achieved though something called "**Scafolding**" [5]. Scafolding is a congnitivist (sometimes defined as constructivist) practice, first discovered by Vygotsky, although he named it differently. It is defined as "a temporary structure which provides help at specific points in the learning process, specifically in the execution of complex tasks". Scaffolding highlights and justifies the concept of a **tutor or mentor**. Tutors present students with a compelling problem or task, provide templates for student data gathering and end-product construction, provide additional references and links, and provide guidance on cognitive and social skills. This approach complies with the natural learning cycle, in which some information must be given to provide the brain something to work on, allow knowledge to be integrated by performing small familiar tasks, and gradually progress to more complex task by relying more and more on students' internal knowledge.

Any balanced approach is based on three transformations of knowledge and one transformation of emotions that must take place in order to achieve deep understanding and competence:

1. **From past to future**. Information given to students is by nature the past. Students must be able to make plans and create strategies: that is to project past learning into de future.
2. **From outside to inside**. Human beings receive knowledge through their senses. It must then be effectively stored. After such process, new knowledge is created, transforming students from knowledge receivers to knowledge producers.
3. **From teaching to learning**. This is a power transformation in which initially students are dependant on outside authority to inform them. Eventually, students take control of their learning taking decisions of how, where and why. Teachers become tutors and

even mentors, through a carefully constructed scaffolding lattice of slowly retracting learning support, until student become experts on the knowledge area.

4. **Motivation**. Students will be presented with knowledge that **is meaningful, that relates to their needs, their work responsibilities, they environment, their culture, and their background**. This will motivate students to be involved and active participants of their learning, as it is interesting to them, and most of all, useful. Another source of motivation is sensation of movement through active learning and the sensation of achievement, through evaluation and feedback.

4.1 Knowledge, Learning and the Brain

David Ausubel said "The single most important factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly" [6]

Many studies about the brain confirm this. 21st century science can help us understand how human beings learn. By now it must be evident that in the construction of our pedagogical model we have drawn mainly from two sciences, one old and one new. The old one is neuroscience. Although not as old as other sciences, neuroscience, the study of the biological structure of the brain, has been present since the 18th century. But this science has rendered new discoveries, mainly by brain imaging that we aim to use in order to develop more effective learning environments. The second one, evolutionary psychology, describes human behavior as product of an organ designed to maximize genetic survival: the human brain. This science also contributes in the development of new learning activities and strategies.

Those studies we have mentioned confirm that knowledge is a "thing" that is somehow related to the physical structure of the brain. We all know that the brain consists of special cells called neurons. But surprisingly, knowledge is not stored in the brain within neurons, as if every neuron was a bit of information. Rather, knowledge is stored as connections between neurons called synapses.

Those connections are very complex. A single neuron can have as many as 10,000 connections. Given the fact that there are about 100 billion neurons in the human brain, it turns out that the number of connections in the brain can outnumber the cells in the human body. But knowledge (being either auditory, motor, semantic, episodic, etc.) is not simply stored as single connections. It is stored as very complex sets of connections between interrelated neurons called neuronal networks [1]. This implies that:

Prior knowledge is a fact. All learners have some prior knowledge. Teachers and tutors must investigate what the knowledge is. Since prior knowledge is concrete, learning must start from concrete knowledge. Students may not be aware of such prior knowledge, since it is intertwined with emotions and semantic memory. Students must be given specific tasks, such as writing assignments or to form discussion groups, in order to help them discover such prior knowledge.

Prior knowledge is persistent. The connections in these physical networks are strong and cannot be deleted nor cannot be reordered. New connections must be built and made stronger so old ones stop being used. Learning activities must start from concrete experiences most likely already stored in student's brain, build new connections and above all, stop using old incorrect connections. Beware that emphasizing incorrect procedures and concepts already stored in students brains can actually reinforce those connections, exactly the opposite we wish to achieve. Focus on the correct, not the incorrect.

Prior knowledge is the beginning of new knowledge. Students have no choice. They must have some sort of previous knowledge about the subject they are about to learn in order to build from that. To build strong neuronal networks for new knowledge, use the natural pathways stored in the brain. Use motivation, emotion and active learning. Good teachers and tutors are not those who explain things correctly, but rather those who put things in an interesting way [7].

As knowledge is recalled and used, its related neuronal networks grow stronger and stronger, acquiring more connections each time. This is why intensive training makes people do things without thinking. For example, we read, write and say our name without giving it a second thought. We have used that knowledge so often, that its associated neuronal networks have deep and dense synapse connections. Athletes, firefighters and policemen have experienced the same about their training.

4.2 Building Knowledge

Teachers and tutors can help students identify useful neuronal networks by asking students to explain what certain concept or topic means for them before the learning process start. After some facts are exposed, teachers and tutors can as questions such as “What does this makes you think of? Is there some part of all this that you find familiar? What is the first thing that comes to mind when you hear about this topic?” Group discussions can help. As students hear other students describe their experiences, common concrete experiences will give clues and will help fire already stored neuronal networks. Also, tutors can have students describe what they have understood of what other students have said, initiating discussions.

Also, as students practice procedures and memory recall, the neuronal networks in which those are stored will fire more often and become stronger. Thus in effect, practice makes perfection and students must be encouraged to practice as much as possible. This is another supporting argument for active learning. Also, whenever a teacher feels that a particular concept, procedure or attitude is particularly important, she must repeat it as much as possible, perhaps until students ask her not to do it any more. Repetition and emotion will strongly increase neuronal connections. This also applies to self-directed learning activities.

Often times, students may be more inclined to look at new concepts and problems in a certain way. Some times they like to apply certain metaphor or simile, or try to solve problems using certain well-known procedure. As long as the metaphor, simile or procedure is not wrong, teacher must encourage such natural talents, but do draw attention to alternatives. With time, as confidence increases and neuronal networks get strongly connected, students will attempt new approaches if they find that they can benefit from those.

In order to improve connections for new neuronal networks, the knowledge they represent can be related to episodic knowledge and emotion, which will enhance recall mechanisms. This can be done in two ways. Teachers and tutors can use anecdotes, stories, similes, analogies and metaphors. But it is also very important that learning activities should ask students to construct their own. Remember that:

Analogy: An inference that if things agree in some respects they probably agree in others. Drawing a comparison in order to show a similarity in some respect; "the operation of a computer presents and interesting analogy to the working of the brain".
Simile: A figure of speech that expresses a resemblance between things of different kinds (usually formed with ‘like’ or ‘as’).
Metaphor: A figure of speech in which one thing is described as if it were another, as in "Life is just a bowl of cherries". In this way, the first object can be economically described because implicit and explicit attributes from the second object are transferred to the description of the first.
Anecdote: Short account of an incident (especially a biographical one) that is used to make a point or that is interesting in

itself (for example, humorous).
Story: A prose narrative.

5 The Need of Social Interaction

Speech and technology are integral parts of being human. Almost surely, each one is a cause of the other. And both are direct causes of the most important genetic changes that define human kind. In the dawn of our species, humans depended on understanding and changing the environment in order to survive. This translated into the use of tools to enhance the limits of the physical body, hitherto the origin of technology in its most simple definition. This is actually not an exclusively human behavior. Elephants, chimps, otters and some other animals have been observed using tools. Technology is not part of our genetic makeup, it must be learned. Soon, the use of tools and the passing of important information about the environment and the use of it became so vast that the power of observation as a means of preserving such knowledge began to reach its limit. At the same time, approximately one hundred thousand years ago, a biological development began to have a heavy effect on the future of the human specie. The sound producing parts located near the trachea moved a little bit further down the neck, allowing more flexibility in the vocal chords which enabled the development of speech (this is why humans tend to asphyxiate while eating). Speech vastly improved the transfer of knowledge. Although it might seem at first that technology caused speech, the picture might be more complicated than it seems and the final answer as whether which caused which has not been fully resolved. This is because humans came into existence with both a certain ability to communicate and a certain ability to use tools. It seems perfectly natural that speech enabled the development of technology through teaching and collaboration; as it is perfectly logical that the need to transmit more complex knowledge demanded more complex speech. It is more probable that a virtuous cycle was formed between speech and technology that constantly drove the development of more complicated human brains[1]. It is not an exaggeration to postulate that technology and speech are integral parts of our biology, since both had direct influence in our genetic makeup in more ways than can be described in this space.

Evolutionary psychology shows us that once humans developed the ability of complex speech and thought, nature imprinted in our genetic information the need to form groups. Human groups (bands, tribes, nations, etc.) are formed through something called **reciprocal altruism**. Reciprocal altruism is the human impulse to help someone in need as an investment for future help. It may not make that much sense in our modern world, but back in time when we were hunters and gatherers, hunger and danger were constant threats. Thus, a little token of help that might not be too important now for the donor, may transform in the future as that extra token of help that will mean the difference between life and death [3].

Human beings have within their brains a wiring that compel them to form groups in order to gain support and strength, and to exchange useful information about the environment through speech [8]. Not only that, but whenever different groups find themselves side-by-side in most situations, they will fill a strong urge to compete. Thus learning environments that enable students to collaborate, debate and discuss, while presenting dangers because of the possible competition that might follow, will have a positive impact on student motivation as they mimic how human beings conquered nature.

[1] This cycle actually stopped when human babies reached the limit of their mother's birth canal (and could not be made to be born earlier since human babies are already basically fetuses compared to other species, including all primates) and when we transformed our environment so much that natural selection on humans actually stopped. That is, when agriculture was developed.

6 Emotions, Attitudes and Values

6.1 Emotions

Motivation also has a direct biological effect on human learning though the firing of emotions. Zull shows that learning and thinking are directly related to emotion. Positive emotions will facilitate the storage of semantic information through human memory, while negative emotions will block the frontal cortex (through the release of adrenaline). Also, the brain will try to store information about potentially dangerous experiences in memory, as fast as possible and as much as possible (through the release of cortisol), so negative emotions may sometimes enhance memorization. Nevertheless, cortisol is more persistent and has deeper effect on the brain since it seems to actually harm the hippocampus, a part of the brain which serves as a gateway to the storage and recall mechanism of memory. This seems to be the cause of post-traumatic stress disorder.

Therefore teachers and tutors must be well aware that emotions have a direct influence on learning. Students also constantly gather more information than we give them. This means that threatening environments (including students, tutors and teachers) must be avoided at all costs and teachers and tutors must constantly motivate and understand student feelings and emotions. Thus teachers that simply give out concrete information about certain knowledge domain can expect poorer results than those that enrich the information through the use of anecdotes and stories that add interest and emotion to the learning process. Also, the use of analogies and similes will help students associate emotions to the learning process by recalling and associating the emotions they have stored about their previous experiences.

6.2 The Amygdala and the Basal Structure Again: Attitudes and Values

We have already pointed out that the human brain filters sensory input in parallel through fear and pleasure control centers which are the amygdala and the basal structure. If the amygadala recognizes the experience as dangerous it will trigger instinctive body actions and attitudes. If certain experience proves to be pleasurable as determined by the basal structure, it will trigger positive attitudes. Both emotional and cognitive content of experience are sent on to the cortex to be processed by the integrative cortex in the parietal and temporal lobes. This is where cognitive meaning begins to form. We have also mentioned that as we struggle to make sense of what our senses are detecting, we are constantly confronted with these options: Should I run? Should I fight? Should I attempt to control? But how are these decisions taken?

For example, were we to see a lion on our path, we would sure take the decision to run. But if we see a life-size picture of a lion, we would contemplate it, perhaps finding beauty in it. That is because these decisions are based on beliefs. Loose lion, bad. Picture, good, even pleasurable. And values are beliefs. One definition of values says “beliefs of a person or social group in which they have an emotional investment” [9], very often giving the holder identity. Decisions based on values drive attitudes. For example if one believes that foreigners are bad, one would have a negative attitude towards them. On the other hand, if one believes that our soccer team mates are good, we display positive attitudes. Why?, because we can remember many pleasurable moments with them.

But one does not need to have fun to acquire a positive belief and thus a positive attitude. We will develop positive attitudes regarding any thing that we believe is important and positive to our life. It is known that soldiers know not skin color. Why?, because it is important for their life, their survival. They need to trust their comrades in arms no matter what the color of their skin or their religions. At least the one that share experiences side by side. This gives us a clue as to how we can change attitudes and values and why do social constructivist strategies are effective in promoting behavioral change.

In the case of collaborative learning for example, attitudes and values are promoted because they are important for the final mark. Positive interdependence makes sure of it. If a team member does not practice the same values or the others, or displays negative attitudes it will not only severely hurt personal performance but team performance as a whole. So there are not only personal advantages for sharing positive beliefs, but there is also peer pressure.

Therefore, in order to promote certain values and positive attitudes it is necessary to set up learning environments that non-threatening and pleasurable in which the exercise of those values and attitudes matters for the student's learning and where it is clearly shown that it also matters for students' in life [10]. We can set up study-cases, videos, trust-based activities, mixed teams, value-practice grading and awards, but above all; teachers promote their values through example. Remember, you are the model. If your values and attitudes system is broken, so will theirs.

7 Synthesis

7.1 Cycles Do Not Have a Beginning

Until now, we have been assuming a sense-integrate-act cycle for learning (Kolb's learning cycle). But if it is truly a cycle, a cycle with the sequence act-sense-integrate makes sense. Students can have a very motivating learning experience if they are presented with an environment that allows and encourages exploration. After exploration, students can process their experience, ask questions, hypothesize and debate the function of different components, areas and mechanisms, etc. This will excite their curiosity and motivate them to learn. We encounter new information by ourselves only by exploring our environment even if it is a synthetic digital one.

7.2 A New Learning Paradigm

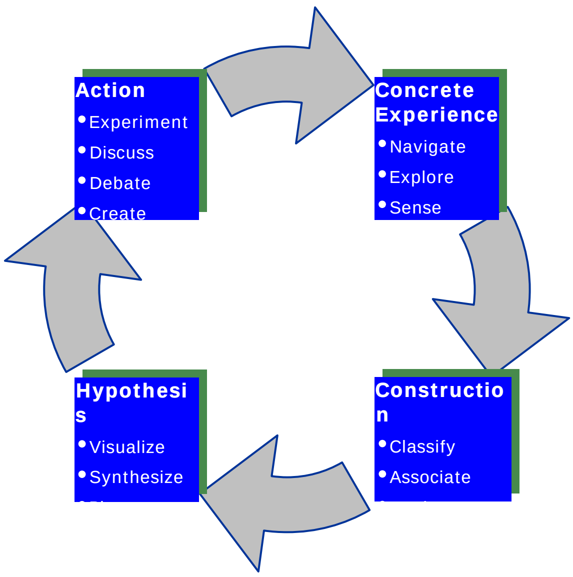

Figure 2. E-LANE's Integrated Learning Processes Educational Model

By analyzing the biological information just presented and a collection of successful educational models[2], the E-LANE project developed and Integrated Learning Process model which allows for the design of effective learning activities, digital materials and tutoring strategies [11]. It consists of following the activities indicated in the learning cycle of figure 2 to progressively acquire the following types of knowledge:

1. **Conceptual and contextual**. This is verbal and visual information which deals with the learner acquiring an awareness and understanding of the concepts, rules, and principles within a specified domain of information. It also deals with teaching the student when or why certain rules and principles apply and the relation of these to other near domains of information. This is the **primary conceptualization stage**, and is mainly concerned with **information analysis**.
2. **Procedural and Problem solving**. This knowledge involves the learner acquiring the skills to correctly use concepts, rules and principles of a specified domain of information and also allows the construction of a mental knowledge base's organization and accessibility that enable the development of problem solving strategies, and creativity and attitudes to be developed later on. This knowledge aims to create in the subjects new **thinking strategies** for problem solving through differentiated (i.e., the ability to understand a given situation and apply appropriate criteria) and integrated (i.e., the ability to restructure knowledge in the service of a given situation) thinking. This is the **secondary construction stage**, and it is mainly concerned with **information synthesis** and **active learning**.
3. **Cognitive complexity**. This knowledge aims to enable students to use the full power of their **creativity** to solve problems, which do not conform to known patterns. Furthermore, it also endeavors to link all that knowledge through higher levels of thinking by reflection and discussion about knowledge, society and life, in order to imprint **values** and observable **behaviors** and **attitudes**.

In this model, the beginning and ending of Kolb’s and Zull’s natural learning cycle are linked together in the conceptualization phase of the model. This allows for traditional teaching as much as exploration and action based learning.

8 Conclusions

Action is not only convenient for learning, it is essential. Action is more than we think. Active learning may involve exploration, hypothesis making, role playing, conversation, argument and debate, making drawings, taking notes, checking out a reference, taking tests and even reading. The only path that seems unproductive is the path that excludes the testing of new ideas. This gives a framework that justifies many of the didactical approaches that will be discussed further down this document.

But whatever the approach to learning is taken, we must never forget that **success in learning is an emotional success**. Students will be proud of their learning if they perceive it as a challenge. Thus learning is always about fear and joy. Learning is not linear. It proceeds by stops and starts, failures and breakthroughs. Whenever students succeed, positive emotions increase. Whenever they fail, negative emotions rise. Teaches and tutors must create environments that avoid fear and stimulate the joy of achievement and human interaction, and

[2] Among them the European Union’s Genius Educational model, Tennyson’s Integrated Congnitive Paradigm and Tecnológico de Monterrey’s educational model

that support and encourage students on their downs and give positive reinforcement and recognition when they succeed.

Also, people feel motivated to learn when they feel that learning is important. And importance is physical. Teachers and tutors must explain how each part in the learning plan fits into their life. So we tell them stories that have beginning, climax and end that relate to their learning experience, and relate their learning to their lives. The bottom line is that, as evolutionary psychology and neurology has shown us, learning is about survival and life.

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