Theory of Learning and the Brain

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Abstract - **An understanding of learning based on the structure and function of the brain. Learning occurs if the brain is not from fulfilling its normal processes. Every person is born with a brain that is an immensely powerful processor. Schooling often inhibits learning by discouraging, ignoring or punishing the natural learning processes of the brain**

Key words - **Learning, Theory, Brain, Schooling, Education**

I. INTRODUCTION

The first part of this paper describes what is a learning in general, and the equation for the learning rate is derived. I also discuss topics concerning the brain because obviously the brain is an integral part of the learning mechanism. However, except for the initial discussions on how the brain develops with age and how that development affects learning.

B. The core principles of brain based learning

- The brain is a “parallel” processor;
- Learning engages the whole physiology;
- The search for meaning is innate;
- The search for meaning comes through patterning;
- Emotions are critical to patterning;
- The brain processes wholes and parts simultaneously;
- Learning involves both focused attention and peripheral perception;
- Learning involves both conscious and unconscious processes;
- We have two types of memory: spatial and rote;
- We understand best when facts are embedded in natural, spatial memory;
- Learning is enhanced by challenge and inhibited by threat;
- Each brain is unique;

The three instructional techniques associated with brain-based learning are: **orchestrated immersion**, where learning environments are created that fully immerse students in a learning experience; **relaxed alertness**, where an effort made to eliminate fear while maintaining a highly challenging environment;
and **active processing**, where the learner consolidates and internalizes information by actively processing it.

II. BRAIN BASED LEARNING

The way the brain works has a significant impact on the kinds of learning activities that are most effective. We need both to help students have appropriate experiences and to help them capitalize on the experience. Three interactive elements are essential to this process:

- Teachers need to orchestrate the *immersion of the learner in complex, interactive experiences* that are both rich and real. A good example is the use of immersion in the teaching of a second language. We need to take advantage of the brain's ability to process in parallel.
- There must be a personally meaningful challenge. This is the intrinsic motivation that is part of the state of mind that we identify as realized alertness.
- There must be intensive analysis so that the learner gains insight about the problem, about the ways in which it could be approached, and about learning generally. We call this the active processing of experience.

Feedback is best when it comes from reality, rather than from an authority figure. We learn best when solving realistic problems. The big picture can't be separated from the details. Because every brain is different we should allow learners to customize their environments. Designers of educational tools should notice parallels between how they approach teaching and how artists approach their craft. ***Educators need to be artists*** in the way they 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 in safe environments.

III. THEORY OF LEARNING AND THE BRAIN

Science is fundamentally not math, physics or equations. It is about human interactions that empower other humans. Can someone totally untrained in science read the following and instantly start using the scientific approach? Most probably not. There is no easy recipe except to study science. You will see that the requirements and complexities of the scientific method will present insurmountable obstacles to most people. Before we embark on defining science, lets examine a common example of how people misunderstand science because this will help to establish why we need a definition

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A. Scientific Approach

Learning: algebra, mechanics, economics, etc., — what do these things have in common? They are all scientific disciplines and therefore share a large number of basic principles in common. It will explain many of the important principles of the scientific method how they are needed in order to produce a useful product. “Science is fundamentally not math, physics or equations. It is about human interactions that empower other humans” [1].

The common example of how people misunderstand science because this will help to establish why we need a definition. Another way of defining science is that it makes previously impossible tasks possible and simplifies difficult tasks. From this point of view, science benefits the less knowledgeable among us more than the better informed who can figure things out for themselves.

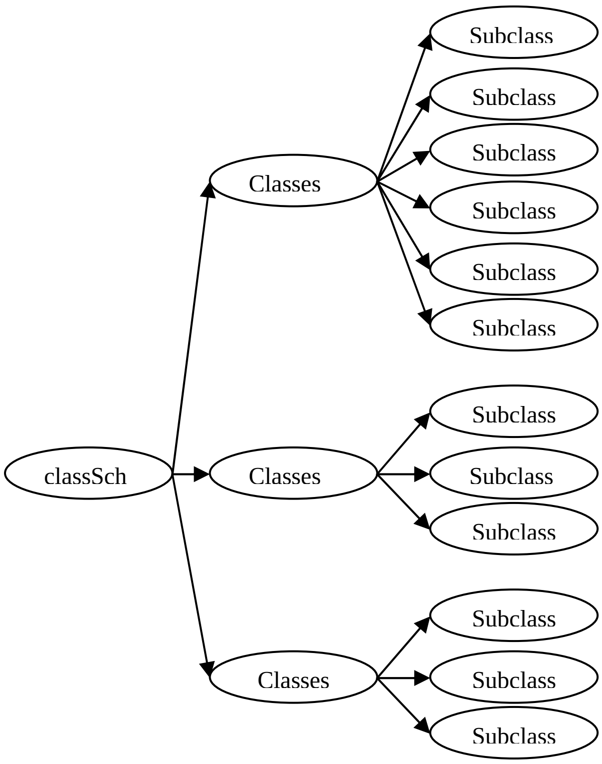

Fig 1: Classification scheme- relationships

The definitions of the scientific method given above do not provide any direct information on how to execute a scientific project. The most general working definition of the scientific approach is that it is a set of uniquely defined objects and the relationships among them. One of the most useful relationships is a classification scheme, which places the objects into classes and subclasses.

Objects must be defined in such a way that they are useful, and in such a way that the relationships between them can be described precisely. And all of these definitions and relationships must be scientifically correct (thats where non-scientists run into problems).

The main ingredient of the scientific method is knowledge but knowledge alone is not enough. That knowledge must be assembled into a structure such that we can see, understand, and exploit the relationships between the objects. Without these relationships, you dont know if you have all the necessary parts or even how to use them. The most common way of building that superstructure is a classification scheme.

In scientific research, you perform experiments, get the data, and write up the results in such a way that others can understand what you did and can reproduce your results. it impossible to put all the ideas together in a coherent way. Once the parallel set concept was introduced, it led naturally to the parallel set exercises.

B. Basic Theory

Scientific results must always be based on some theory or principle that can be verified by others. Very few concepts stand alone, independently of anything else. In other words, anything that someone claims works, better have a good explanation of why it works; otherwise, it is suspect. The *explanations* are often more important than the procedures they explain. Of course, there are always a few concepts that defy explanation, and it is extremely important to clearly classify them as “valid principles without explanations”. In those cases, how are we to know that they are valid? They can be considered valid only after establishing an undeniable record of experimental verification. It is important to label these clearly because procedures without explanations are more difficult to apply and these procedures are subject to change as we learn more and understand them better. The nicest thing about methods that have good explanations is that we don’t need to be told every detail about how to execute the procedure—we can often fill in the details ourselves from our understanding of the method. This is not only because of the high probability of such procedures being wrong, but also because it is the explanation that helps us to use the procedure correctly. Most instructions on how to do something without any explanation of why they work have little value in a scientific approach. This is not only because of the high probability of such procedures being wrong, but also because it is the explanation that helps us to use the procedure correctly. . In any real life procedure, it is nearly impossible for anyone to describe all the necessary steps of a procedure under all contingencies. It is an understanding of why it works that allows each person to alter the procedure to meet the specific needs of individuals and changing circumstances. As teachers become more educated, they should be able to replace more dogma with a deeper understanding of the underlying principles. This should significantly enhance efficiency and ease of learning for the student. Most people are aware that scientists must study all their life, not only when they are in college working for their degrees. However, most are unaware of the extent to which scientists devote their time to education, not only to learn but also to teaching everybody else, especially fellow scientists. A scientist therefore often evolves into more of a teacher than say, a piano or school teacher because of the broader range of “students” they encounter as well as the breadth of the subjects that they must cover. It is truly astounding, how much you need to know in order to make just a small new discovery.

The physical principle we use to derive our learning equation is the linearity with time. Such an abstract concept may seem to have nothing to do with piano and is certainly non-biological, but it turns out that, that is exactly what we need. Let’s explain the concept of “the linearity with time”. It simply means proportional to time. For example, if we learn an amount of technique L (stands for Learning) in time T, then if we repeat this process again a few days later, we should learn another increment L in the same T. Thus we say that L is linear with respect to T in the sense that they are proportional; in 2T, we should learn 2L. Of course, we know that learning is highly non-linear. If we practice for 4 hours, we are likely to gain a lot more during the first 30 minutes than during the last 30 minutes. However, we are talking about an optimized practice session averaged over many practice sessions that are conducted over time intervals of years. If we average over all of these. learning processes, they tend to be quite linear

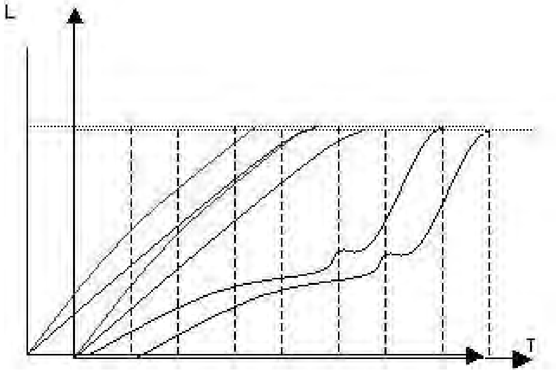

Fig 2: Relationship between learning and time

Certainly within a factor of 2 or 3, linearity is a good approximation, and that amount of accuracy is all we need. Note that linearity does not depend, to first approximation, on whether you are a fast learner or a slow learner; this canges only the proportionality constant. Thus we arrive at the first equation, (1):

$$L = kT \qquad (1)$$

where L is an increment of learning in the time interval T and k is the proportionality constant. What we are trying to find is the time dependence of L, or L(t) where t is time (in contrast to T which is an interval of time). Similarly, L is an increment of learning, but L(t) is a function. We have control over L; if we want 2L, we simply practice twice. But that is not the L that we retain because we *lose* some L over time after we practice. Unfortunately, the more we know, the more we can forget; that is, the amount we forget is proportional to the original amount of knowledge, L(0). Therefore, assuming that we acquired L(0), the amount of L we lose in T is , (2):

$$L = -kTL(0) \qquad (2)$$

where the k’s in equations (1), (2) are different, but we will not re-label them for simplicity. Note that k has a negative sign because we are losing L. (2) leads to the differential equation, (3):

$$\frac{dL(t)}{dt} = -kTL(t) \qquad (3)$$

where d stands for differential (this is all standard calculus), and the solution to this differential equation is (4):

$$L(t) = Ke^{-kt} \qquad (4)$$

where e is a number called the natural logarithm which satisfies. (3) and K is a new constant related to k (for simplicity, we have ignored another term in the solution that is unimportant at this stage). (4) tells us that once we learn L, we will immediately start to forget it exponentially with time if the forgetting process is linear with time. Since the exponent is just a number, k in Eq.(4) has the units of 1/time. We shall set k = 1/T (k) where T(k) is called the characteristic time. Here, k refers to a specific learning/forgetting process. Therefore, determining accurate values for T(k) for each process is generally not possible, so in the numerical calculations, we will have to make some “intelligent guesses”. Then Eq (4) becomes (5):

$$L(i,t,k) = K_i e^{-k\frac{t_i}{T(k)}} \qquad (5)$$

for each repetition i and learning/forgetting process k.
Let’s examine some relevant examples (for example- piano playing). Suppose that practicing 4 parallel drill for 10 minutes. We assign i = 0 to one parallel set execution, which may take only about half a second. You might repeat this 10 or 100 times during the 10 minute practice session. You have learned L(0) after the first parallel set. But what we need to calculate is the amount of L(0) that we retain after the 10 minute practice session. In fact, because we repeat many times, we must calculate the cumulative learning from all of them. According to Eq. 1.5, this cumulative effect is given by summing the L’s over all the parallel set repetitions, (6):

$$L_{Total} = \sum_i K_i e^{-\frac{t_i}{T(k)}} \qquad (6)$$

IV. Conclusion

The consider issues are insignificant part of problems, which are discuss with some science - psychology, pedagogy, instructional design. The computer communications and technologies have grown and a learning have got to discuss and in this aspect.

V. References

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[2] Chuan C. "Fundamentals of Piano Practice”