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On the study of memorization trends

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ABSTRACT

The purpose of this paper was to decipher the rate at which memorization of the stuff that required memorization in the area of axioms and proofs of theorems, and to calculate the various amount learnt at particular periods. The usage of differential equation was employed to model the trend. The paper contributes to the literature by documenting that memorization of large number of stuff could be done even beyond perceived imaginations.

Keywords: Memorization, differential equations, model, mathematical stuff.

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INTRODUCTION

Throughout the history of Mathematics, differential equations (Zill, 2001) have played many authentic roles to enhance the way society thrives in various areas of carrying out their activities. The study of topology for instance involves the study of theorems and their proofs as well as axioms which spell out the distinctions of spaces. The laws of the universe are written in the language of Mathematics. It goes without telling that algebra is sufficient to solve many problems, but the most interesting natural phenomena involve change and are described by equations that relate to changing quantities. In view of the above, because the derivative $\frac{dx}{dt} = f'(t)$ of the function *f* is the rate at which the quantity $x = f(t)$ is changing with respect to the independent variable *t*, it is natural that equations involving derivatives are frequently used to describe the changing universe. An equation relating an unknown function and one or more of its derivative is called a differential equation.

The study of differential equations has three main purposes:

1. To discover the differential equation that describes a specified physical situation.
2. To find- either precisely or approximately- the appropriate solution of that equation.
3. To analyse and interpret the solution that is found (Edwards and Penny, 2004).

Memorization forms part of the learning process. This calls for application of the ability to memorize salient stuff.

Memorization processes

Memory is a highly complex process involving multiple components working simultaneously (Richards, 2008).

It is worthy to note that to perfect one's memorization skills the following memorization techniques will help students remember, retain, and understand all types of information.

Use acronyms: Memorization happens when people get ideas or information to stick. This is why creating acronyms is incredibly useful and effective.
Link it: The best way to memorize information is to link key concepts to things a person already knows or enjoys. A dancer might link important equations to dance concepts.
Use acrostics: Acrostics are another creative way to remember and retain information. This means that the student needs to create a sentence where the first letter of each word links to a concept.
Retype your notes: Retyping notes is another great way to refresh one's memory regarding important coursework.

Tell someone else: Another great memorization technique is to actually explain key or new concepts to another person.
Break it down: It is important that people really break down key information into easy to digest sections.
Rhyme it: Rhyming key terms and ideas into little songs or poems can make it easier for a person to remember key ideas later on.
Imagine it: Images go a long way when it comes to memorization.
Sense it: Using all of the sense during studying can really help people memorize key information.
Format your notes: Using different coloured and sized font when retyping notes can really go a long way to memorization.
Start early: It is important that students start memorization as early on as possible.
Mix it up: It is important that students try many different study and memorization techniques (Memorization Techniques for Students).

Surprisingly, meditation and memory are linked. Research proves that meditation changes the physical structure of the brain in remarkable, positive ways - including improving attention and memory. So what is the connection between meditation and memory? Mindfulness meditation has been reported to produce positive effects on psychological well-being that extend beyond the time the individual is formally meditating (Holzel et al., 2011). Everyone around the water cooler knows that meditation reduces stress. But with the aid of advanced brain scanning technology, researchers are beginning to show that meditation directly affects the function and structure of the brain, changing it in ways that appear to increase attention span, sharpen focus and improve memory (Cullen, 2006). Although research has found that long-term mindfulness meditation practice promotes executive functioning and the ability to sustain attention, the effects of brief mindfulness meditation training have not been fully explored (Zeidan et al., 2010).

METHODOLOGY

A differential equation model would be formulated and it would be solved. It would then be used to predict the results. The study involved a trend of how mathematics could be grappled with in the aspect which called for memorization of theorems and their respective proofs and related stuffs. Differential equations have been used in a variety of applications in Dontwi and Obeng-Denteh (2011), Obeng-Denteh (2011) and Obeng-Denteh et al. (2012).

Formulation of model

Concerning the theory of learning, the rate at which a subject is memorized is assumed to be proportional to the quantity that is left to memorize.
Let *M* be the total quantity to be memorized.
Let $A(t)$ be the quantity memorized in time t (Zill, 2001).

Then $$\frac{dA}{dt} \propto (M - A) \quad (1)$$

which implies that

$$\frac{dA}{dt} = k(M - A) \quad (2)$$

It thus follows that

$$\frac{dA}{dt} + kA = kM$$

The integrating factor therefore will be $e^{\int kdt} = e^{kt}$
Multiplying both sides with the integrating factor we have,

$$e^{kt}\frac{dA}{dt} + kAe^{kt} = kMe^{kt}$$

Therefore

$$Ae^{k_1 t} = \int k_1 M e^{k_1 t} dt + k_2$$
$$= Me^{k_1 t} + k_2$$
$$A(t) = M + k_2 e^{-k_1 t}$$

At $t = 0$, $A(t) = 0$, hence

$$0 = M + k_2$$
$$k_2 = -M$$

Therefore

$$A(t) = M - Me^{-k_2 t} = M\left(1 - e^{-k_2 t}\right) \quad (3)$$

This means that as $t \to \infty$, $A(t) \to M$.
The explanation to this is that with time, the student can memorize all the *M* information available.
Also the rate of absorption is affected by the constant k_2.
If k_2 is small then it will take a longer time, as compared to it being large, for the student to memorize all *M* data. k_2 can be calculated by knowing an additional information

about the student after time *t*.

Now, say, at time *t*, $A(t)=A$, then k_2 can be calculated as follows:

$$A = M\left(1-e^{-k_2 t}\right)$$

$$\frac{A}{M} = 1-e^{-k_2 t}$$

$$e^{-k_2 t} = 1-\frac{A}{M}$$

$$k_2 = -\frac{\ln\left(1-\frac{A}{M}\right)}{t} \qquad (4)$$

This means that if an initial small time *t* is taken to provide a large $A(t)$ then k_2 will be large making $A(t)$ approach *M* faster with time. The opposite is also true.

RESULTS AND DISCUSSION

The constants in Equation 3 are to be computed. The following data were at hand:

$M = 500$, $A(1) = 100$

Then substituting for M, $A(1)=100$ and $t=1$ would yield

$$\begin{aligned} k_2 &= -\frac{\ln\left(1-\frac{A}{M}\right)}{t} \\ &= -\frac{\ln\left(1-\frac{100}{500}\right)}{1} \\ &= -\ln(0.8) \\ &= 0.223144 \end{aligned}$$

Then

$$A(t) = 500\left(1-e^{-0.223144t}\right)$$

From Table 1, it is evident that students could use less than five days to memorize over three hundred mathematical structures and the graph is found in Figure 1.

It is to be noted that as $t\to\infty$ the term $500e^{-0.223144t}$ approaches zero. Such a term is usually called a transient term or transient solution; the remaining term 500 is called the steady-state term or steady-steady solution. It is interesting to observe that as t increases the graphs of all members of the family are close to the graph of the particular solution $y=500$. This is because the contribution of $500e^{-0.223144t}$ to the values of a solution becomes negligible for increasing values of x. While this behaviour is not a characteristic of all general solutions of linear equations, the notion of a transient is important in applied problems (Zill, 2001). The solution $A(t)$ described the situation at any time $t>0$. Of course, $A(t)$ is a continuous function that takes on all real numbers. This reveals that the interval of operation is

Table 1. Days and their corresponding expressions memorized.

t	$A(t)$	*t*	$A(t)$
0	0	16	486
1	100	17	489
2	180	18	491
3	244	19	493
4	295	20	494
5	336	21	495
6	369	22	496
7	395	23	497
8	416	24	498
9	433	25	498
10	446	26	498
11	457	27	499
12	466	28	499
13	473	29	499
14	478	30	499
15	482	31	500

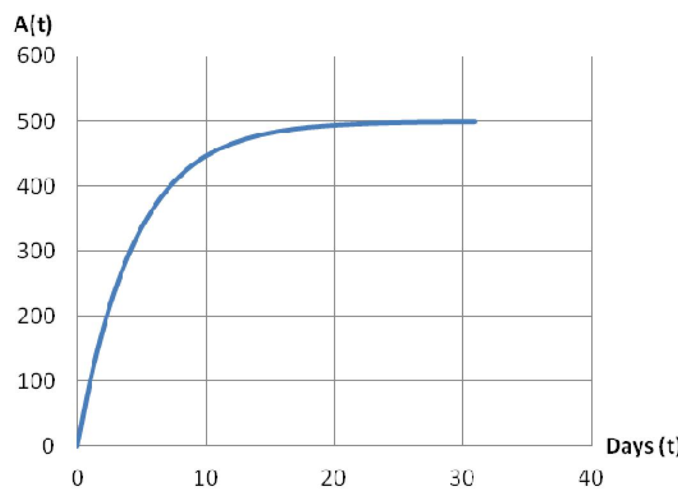

Figure 1. Depicts the numbers of days against the quantity memorized.

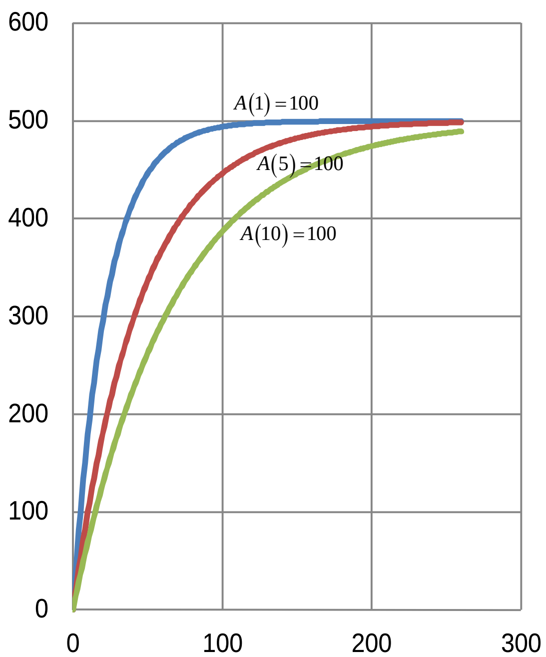

Figure 2. Sketch of various $A(t)$ with $M=500$ but different known time *t* for $A(t)=100$.

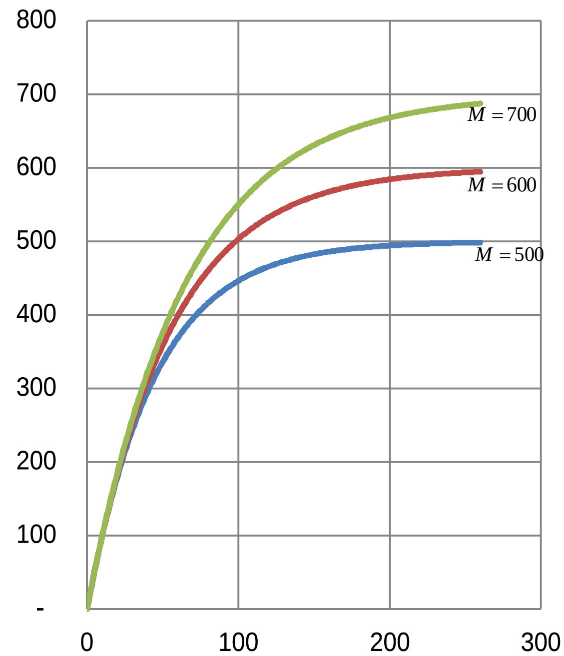

Figure 3. Sketch of various $A(t)$ with $A(10)=100$ but different *M.*

$A(t)\leq A<\infty$. But since we are talking about a number of structures to be studied, common sense dictates that A can take on only positive integer values. See graphs of the steady-state and transient terms.

In Figure 2, three students with 500 mathematical theories to memorize took three different times (that is, 1 day, 5 days, and 10 days respectively) to memorise 100 of them. It can be observed that the student that took a day to study 100 theories finished first, followed by the one who took 5 days to study the 100 theories, and lastly the one who took 10 days. This is actually to be expected and not different from the norm.

In Figure 3, three students having different number of theories to memorise took 10 days to study 100 of them. Observing from the graph obtained by using the model, the student with larger number of theories tends to memorise quickly than those with lesser theories to memorise.

In comparing with Dontwi et al. (2013), it was observed from that paper that a person with a high constant of retention (0.9662) and a high absorption rate (0.9210) will be able to memorize four hundred and thirty words in five days and four hundred and thirty-five words in ten days. On the contrary, a person with low constant of retention (0.2245) and low absorption rate (0.0523) will be able to memorize twenty-three words in five days and forty-one words in ten days. This goes to prove that a person with a high retention constant and absorption rate is able to recall more than all the others.

CONCLUSION

A differential equation model has been formulated, solved and used to study the trend of how students could memorize the aspects of their study which called for memorization. The differential equation mimicked the real life situation which is astonishingly valid. The research revealed that students could memorize large number stuffs even beyond their perceived imagination even though forgetfulness was not considered in the study under review.

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