The Societal Learning Cycle

An Honors Thesis (HONRS 490)

by

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Illustrations</td>
<td>i</td>
</tr>
<tr>
<td>Abstract</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Thesis</td>
<td>2</td>
</tr>
<tr>
<td>Definition of Society</td>
<td>3</td>
</tr>
<tr>
<td>History of Individual Learning Curve</td>
<td></td>
</tr>
<tr>
<td>And Business Cycle Theory</td>
<td>4</td>
</tr>
<tr>
<td>Synthesis Into Societal Learning Cycle</td>
<td>10</td>
</tr>
<tr>
<td>Motivating Forces Of Movement Along Cycle</td>
<td>12</td>
</tr>
<tr>
<td>Evidence of Movement Along The Cycle</td>
<td>15</td>
</tr>
<tr>
<td>Problems of Not Using Cycle</td>
<td>18</td>
</tr>
<tr>
<td>Benefits of Using Cycle</td>
<td>20</td>
</tr>
<tr>
<td>Conclusion</td>
<td>22</td>
</tr>
</tbody>
</table>
List of Illustrations

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>5</td>
</tr>
<tr>
<td>Figure 2</td>
<td>6</td>
</tr>
<tr>
<td>Figure 3</td>
<td>6</td>
</tr>
<tr>
<td>Figure 4</td>
<td>7</td>
</tr>
<tr>
<td>Figure 5</td>
<td>8</td>
</tr>
<tr>
<td>Figure 6</td>
<td>10</td>
</tr>
</tbody>
</table>
Abstract

This project describes a hypothetical model of the development of levels of knowledge in a society. The model was derived from the learning curves of an individual and the models of progression that are used in the business world. Some possible forces that move the society along the model to higher levels of knowledge are identified along with ways to identify that the movement has occurred. Finally, there is a discussion of the problems that could occur in a society from not understanding and utilizing the model and benefits of understanding and utilizing the model.
Introduction

This project began when I read an article which stated that politicians were always blaming each other when something was wrong with the state of education and praising themselves when it was right. This statement led me to consider the fact that the state of education does seem to be intermittently good and bad. This realization then lead me to consider this cyclic nature in many other areas as well. As my thoughts lead me deeper and deeper into generalizing the concept of the cycle, I recalled what I had learned in my honors colloquia about a learning curve and what I had learned in my economics class about a business cycle. Both of these topics represented a cyclic nature in the development of either an individual or a business. These topics seemed to support what I have begun to think of as a "societal learning cycle". The result of my thoughts, months of research and hard work are presented here.

Thesis

My thesis is that there is a cyclic nature to society which I will call a societal learning cycle. This societal learning cycle is similar to the learning curve of an individual and the cycle of a business. With the proper analytic tools and months of investigation into historical data, I am confident that my thesis
can be supported mathematically. However, this paper shall try to support the existence of the societal learning curve by presenting logical arguments about the cycle's hypothetical nature and by presenting the possible causes and evidence of movement along the cycle. A mathematical analysis could follow in further research.

For this present analysis, however, I will first present my definition of society then give the history of the individual learning curve and the business cycle from which my thesis is derived. Next, I will present the societal learning cycle and give some possible forces affecting movement along it and some evidence that the movement has occurred. Finally, I will indicate possible problems and benefits that could result if the cycle is understood and utilized.

Definition of Society

In order to effectively analyze my thesis I must first start from a common definition of society, by no means an easy task. Many possible definitions have been proposed. The definitions that are most common relate to an association of individuals with common institutions, traditions, values, and interests. Some definitions include the stipulation that the individuals are working together for a common goal (1).

I will, however, define society as the interaction between individuals seeking to satisfy their needs and as the "things" that develop from the interaction process and the satisfaction of needs. The first part of that definition specifies that society
is a group of individuals. These individuals make up part of society. The second part of society is those individuals interacting with each other or groups interacting with other groups. The nature of the interaction, the ways and means of interacting, are determined by and determine the nature of society. The third part of the definition is the "things" that develop from the interaction. "Things" can either be defined narrowly or broadly. My personal definition of "things" is rather broad and includes such items as language; facial expressions; abstract ideas such as truth, beauty, love, and justice; concrete objects such as art, furniture, the Constitution; organizations such as the Boy Scouts and MADD; and business corporations to a lesser extent. These "things" are, at the start, creations of society, but they can later become reasons for future interactions.

This definition is admittedly broad, but I think that this broadness is necessary because so many "things" develop from and help to develop society. Other definitions, refered to above, do not include enough of the dimensions and the complexities of our society. The other definitions speak only of the individuals and the reasons for the interaction. They do not define the nature of the interaction or the results of the interaction, which I feel are a necessary component of our modern society.

History of Individual Learning Curve and Business Cycle Theory

The learning curve of individuals was first proposed and tested in the early 1920's. Over the last seventy years the
The individual learning curve has undergone many updates and improvements. Businesses have also adapted the learning curve to their needs and call this adaption the experience curve.

When the learning curve was first proposed in the early 1920's, its shape was hypothesized in two different forms. The earliest form was hypothesized by Hull (2). His theory of the learning curve is shown in Figure I.

![Graph showing cumulative time or practices](Figure I)

**Hull's Learning Curve**

Hull's curve showed that the time to complete an assigned task diminished with the cumulative time spent performing the task or the cumulative number of practices that the individual performed.

A second theory was proposed only a short time later by Culler (3). His theory of the learning curve is shown in Figure II.
Culler's Learning Curve

Culler's curve showed that the rate of correctly completing a task increased with the cumulative time spent performing the task or the cumulative number of practices that the individual performed.

In the 1930's businesses adapted Hull's theory of the learning curve to predict the decreases in the time necessary for a worker to produce one unit of output. This is called the experience curve (4), and is shown shown in Figure III.
The experience curve shows that the time to produce one unit of output decreases with the cumulative output of the worker. As the worker reduces the time that he needs to produce a unit of output, fewer workers need to be hired to produce increasing amounts of output, and therefore the curve represents possible cost savings for the business. For this reason cost per unit is often the variable that is represented on the vertical axis instead of time per unit.

Businesses later adapted the learning curve further. This second version of the business learning curve was developed by Boeing and Stanford and is named after them (5). The Boeing and Stanford learning curve is graphed on log-log axis and is shown in Figure IV.

Figure IV
The Boeing and Stanford Learning Curve

This business learning curve shows that the time or cost per unit does not immediately begin to decrease as cumulative units are
increased. Boeing and Stanford call this first phase "getting out the bugs." After this phase, time and costs per unit begin to decline rapidly as cumulative units are produced. This phase is called the "accelerated cost reduction" phase. Eventually the curve hits the "leveling off" phase and further cost reductions are small to nothing.

Over the next ten years, learning curves were improved and updated. Also developed was what was known as the curve of forgetting. The learning curve and the forgetting curve were then combined onto the same graph and the result was what is known today as the classic learning curve. References as early as 1950 refer to the curve in Figure V as the classic learning curve. This seems to indicate that the curve was adapted and accepted by the educational community in a span of only ten years. The classic learning curve is the combination of the work of many theorists and educational practitioners and is not attributed solely to any one person or group (6).
The classic learning curve shows that the rate of correctly completing a task at first increases with the cumulative time spent or number of practices, then plateaus, and then decreases slightly due to forgetting. Forgetting however does not decrease the rate of correct responses back to the starting point. Rather, the forgetting curve hits a plateau from which relearning could possibly begin and proceed upward as with the first learning phase. Overall, the curve shows a steadily upward movement or progression.

The classic learning curve has persisted for many years and has only recently been changed and improved again. The changes are not to the form of the curve but to the definitions and reasons for the increases and decreases. The decreases are no longer considered to be forgetting and the following increases are no longer considered to be relearning. The plateaus are also being explained. The Encyclopedia of Educational Research says that the "plateaus in learning curves reflect the shift from one set of cognitive, motivational, and physiological limits to another" (7). This new definition shows that all phases of the learning curve represent learning only with different ways and means of learning emphasized at each point. Current research by one faculty member at Ball State University indicates that the phase of the learning curve which was formerly the curve of forgetting could really be a period of integrating the newly learned task with older information, along with a period of finding uses for this new data in the individual's life (8).

Therefore, history has seen the evolution of the learning
curve from a description of the learning of a specific task by one person to a description of the rate of learning in general. The learning curve was also adopted by business to predict their productivity and costs. The learning curve then prompted changes in the definitions of learning.

Synthesis Into Societal Learning Cycle

My thesis is that there exists a curve similar to the individual learning curves and the business curves in our society as a whole. An estimate of the nature of this societal learning curve is shown in Figure VI.

![Graph showing the general knowledge level over cumulative time]

Figure VI

The Possible Shape of the Societal Learning Curve

The societal learning curve is similar in nature to the classic
learning curve but includes the modern definitions discussed earlier, and the vertical axis is labeled to reflect a general knowledge level instead of a rate of correctly completing one task or producing a good. This label change is appropriate as one moves from the knowledge of a specific individual to the combined knowledge of society in general. As the individual learns something faster, that person adds more to his or her personal knowledge level which in turn adds to the knowledge level of the society to which the person belongs.

This societal learning cycle is as old as man. As early as man began forming societies, he began learning and passing that knowledge on to society. The human elements of society in turn learned and taught others many new things; thus the knowledge level of the society grew. As man learned, integrated his new knowledge, and shifted his ways of thinking about things, the societal learning curve rose and fell, though it always headed in a generally upward direction. Therefore movement along the societal learning curve could be defined in many different ways: discovery and integration, creativity increases and decreases, productivity increases and decreases, knowledge increases and decreases. The definition depends on what forces cause movement to occur and what changes in the society give evidence that movement has occurred. Some of these motivating forces and evidence will be discussed next.
Motivating Forces Of Movement Along Cycle

When I was considering some possible forces affecting movement along the societal learning cycle, many forces were considered. The list that follows represents what seems to be the strongest forces acting on the societal learning cycle. These forces include human needs, technology, world competition, individual achievements and the increasing pace of life. Some of these forces can affect the movement by initiating it and others can affect it by accelerating it.

Abraham Maslow is generally credited with the discovery of the categories of human needs. In 1968, he defined the categories as a hierarchy beginning with survival needs, leading to safety needs, progressing to social needs, and finally ending with what Maslow called a need for self-actualization (9). Later research has added minor categories, or changed terminology, but Maslow's basic hierarchy still stands. From the earliest times with the most basic requirements, man has had to learn how to meet his needs. As man strove to discover ways of satisfying his needs, he learned about things that do and do not work to satisfy those needs, he also discovered the process of discovering need satisfiers. Once discovery of need satisfiers was complete, man could then integrate those satisfiers into his life and settle in contentedly. Before long, however, the next need in the hierarchy would have to be filled and the process would start all over again. As we can see, the pattern of need fulfillment closely matches the societal learning curve which I have proposed.
Man today is in general trying to satisfy his need for self-actualization which Maslow identified as the highest ordered need. Some are still trying to satisfy their more basic needs and in the past there were some who were able to reach self-actualization before everyone else, but the general population is now striving for self-actualization. The big questions now are will we ever completely satisfy our need for self-actualization and if we do, what is beyond. We will have to leave these questions for the world’s philosophers. Important to note, however, is that the time necessary to integrate the fulfillment of each need seem to be stretching out. When man was first fulfilling his survival needs, it did not take him long to see the usefulness of caves and fire. The fulfillment of social needs, such as language and government, is considered by some to still be integrating. Each new "thing" that we invent or discover to fulfill ourselves or make our lives easier takes successively longer to make useful or to integrate. As proof, consider the difference in the amount of time it took to integrate and make useful some early inventions such as rubber or automobiles versus the long and continuous integration of recent inventions such as lasers and computers.

Man's needs push him along his learning cycle and also push him to invent need satisfiers. These newly invented satisfiers, if they are physical things, are often referred to as technology. Technology, itself, can also become something that pushes man along his societal learning cycle. Once a technology is discovered and integrated into society, that technology can then
become a motivating force for new learning. The technology spawns other related new technologies and new areas of learning.

New technologies, recently, have been developed at increasing rates with increasing levels of complexity. The majority of new technologies were developed by inventors in only a few countries. The competition for the development of new technologies between the countries can be another factor that motivates movement along the societal learning curve. Competition can cause the discovery process to accelerate. Even, in some sense, the cooperation inherent in the competition can cause the movement along the curve to accelerate. As someone in one country finds the answer to the question of the day and that information reaches the rest of the world nearly instantaneously, other inventors in other countries can find ways to integrate the new technology or knowledge and begin working on tomorrow's question of the day.

In the past, technological innovation was achieved by a few exceptional individuals acting mostly alone. Though some individuals today give society great new technologies and opportunities for learning and moving along our societal learning cycle, recently, technological innovation has become more group, corporation, or even, nationally oriented. For example, at the turn of the century Wilbur and Orville Wright built the first flyable airplane in their bicycle shop. Today, my father works with dozens of other people to design and build one piece of electronic equipment that goes into an airplane.

The achievers of this world, whether they be individuals or groups, push themselves in order to gain the rewards that go along
with the movement to higher levels of knowledge. Movement to higher levels of knowledge have historically lead to a more affluent society, greater leisure time, and a greater level of self-actualization. Gaining more of these and other rewards is a very strong motivating force for movement along the learning cycle.

Evidence of Movement Along the Cycle

There are ways of identifying the movement along the societal learning cycle. The movement can be identified by examining historical records of creative output, productive output, education levels, the current phenomena of the "information crunch" and the trend to passive instead of active learning.

For many years businesses, especially manufacturing businesses, have used the version of the learning curve, which they call the experience curve, referred to earlier, to identify the amount of cost savings per unit of output as their workers gain experience in cumulative units of output. The faster the workers learn, the faster the business moves along its experience curve and the more cost savings they experience per unit. Therefore, businesses have historically used output rates to identify the movement along their version of the learning curve. Similarly, we can also apply this to our societal learning cycle, which we have already established is also derived from the learning curve. However, society's learning involves much more than simply learning to do a job better. Society's output must be
measured in terms of our productivity as well as our creative and educational outputs.

A society's productivity could be measured by the value of its gross national product. Of course, this measure is affected by many influences other than the learning cycle, such as the effects of supply and demand, but its pattern of increases and decreases can still be discernible and measurable. Other evidences of societal productivity changes could be export rates and key industry productivity changes.

A society's creative output could be measured by its invention rates, evidenced by the rate of patent applications. Numbers of art exhibits, recitals, and book publications could also give evidence of movement along the learning cycle as the output of these increase and decrease. Educational output could be and is measured by SAT scores, other standardized test scores, graduation rates, grade point averages, degrees held, and grades completed.

All of these social outputs could be measured over time to show that their pattern of increases and decreases is similar to the societal learning curve. These outputs would, of course, have to be adjusted for extraneous factors that do not enter into the learning of a society.

As the productive, creative, and educational outputs of our society grow today, it is becoming necessary for every individual to acquire and retain knowledge at faster rates and earlier ages. This is popularly called the information crunch. The information crunch is another factor that gives evidence to our movement along
the societal learning cycle. As society as a whole moves further and further along the cycle to higher and higher levels of knowledge, children have more knowledge to assimilate in a shorter time. As proof, consider when my grandfather was in school in the 1920's; in grades 1 through 6 he was taught reading, writing and math with a sprinkling of history and religion. When my parents were in first grade in 1946 and 1949, they were taught their colors, numbers and abc's. My older sisters learned these things in kindergarten in 1969 and 1970. When my younger sister entered kindergarten in 1983, she had to take a test to prove that she already knew her colors, numbers, and abc's to be admitted to kindergarten. My younger sister then learned to read, write and do math in kindergarten, the same as my grandfather learned for five years in grades 1 through 6 in the 1920's.

The information crunch makes it necessary for more knowledge to be assimilated faster so that it is becoming impossible for both children and adults to "learn the old fashioned way," by trial and error. Instead of learning from nature and the person's own thoughts and feelings, information has to be fed to the person passively because there is too much to learn and too little time to figure it out actively, on one's own. Children today learn to spell and speak Spanish from Sesame Street instead of the "old fashioned way," by talking with their parents or teachers. The children passively sit in front of the television and are taught spelling and Spanish instead of experiencing Hispanic culture and interacting with Hispanic people because this would take too long and there are many other languages to learn to prepare the child
for today's interconnected world. This trend to passive instead of active learning provides further evidence of our movement along the societal learning cycle to higher and higher levels of knowledge. There is so much knowledge to acquire that there is no time to truly experience it all. We only have time for the facts. Research shows that interactive learning is the best model for learning (for example see Hillocks [10]), but my own experience in the educational system of the United States has been mostly through the presentation style, a passive style of learning.

Problems Of Not Using Cycle

The old saying goes, "A little knowledge is a dangerous thing." This saying means that knowledge in insufficient quantities or without proper preparation can create major problems. The major problem that could arise from ignorance of the societal learning cycle is continued movement without proper preparation and control. Movement to successively higher levels of knowledge could create problems due to emotional immaturity, the capacity levels of the human brain, and gaps between those who are in step with the higher levels of knowledge and those who are not.

Continued movement along the learning cycle could cause problems because we as a society may not be ready emotionally, physically, or socially for the higher knowledge level, the level of interaction that the new knowledge level requires, or the
technology that the new knowledge level may create or require. Movement into these areas when the society is not ready can have disastrous results. Henry David Thoreau once said that "men have become the tools of their tools"(11). This problem is already evident in our present society. When science discovered the energy released from splitting the atom, our society was not, and still is not, ready for the level of responsibility and emotional control that is required to utilize the new knowledge level safely. The results were disastrous: the bombing of Japan during World War II, nuclear power plant melt downs, nuclear fall out, and the threat of nuclear war hanging over the whole world for decades. Movement to higher levels of knowledge without even being prepared for the one that we are at presently could create many problems, some of which could be devastating.

Another potential problem that could arise with continued movement along the societal learning cycle is limitations on the human intellect and limitations on the rate at which we can integrate new knowledge. Carl Sagan points out in his book, The Dragons of Eden, that "the human brain is characterized by some [two to the power of] $10^{17}$ synapses." "This is an unimaginable number, far greater, for example, than the total number of elementary particles in the entire universe" (12). The potential problems of limitations in brain capacity are far in the future. There may be a limit, however, on the rate at which we can take in new information and integrate it into our lives. The information crunch that we are experiencing today could continue to grow and create problems for education and anyone with a desire or need to
A third potential problem that could arise with continued movement along the societal learning curve is an ever widening gap between those who stay in step with the general knowledge level of the society and those who fall behind. Those who fall behind could become incapable of functioning in the society or be hurt by their lack of knowledge. This problem applies to businesses also. Those businesses that can not compete and keep up with the level of the other business will not last very long. This gap is detrimental to society because the individuals and businesses that can not keep up are counted into the society and can keep the society from proceeding to higher levels or keep it from being prepared for the new level that the society is entering.

These problems are serious and steps should be taken to avoid the negative results of the problems. Continued movement is inevitable, but our level of preparation and continuity are controllable.

Benefits Of Using Cycle

There are two major benefits of understanding and utilizing the societal learning cycle. One is the ability to plan for the future and the other is continued movement to higher knowledge levels.

Understanding and using the learning cycle would give our society the ability to plan to make the most of the upward movement and decrease the effects of the downturns. Being able to
plan for the future would give us the chance to prepare ourselves and our society for the changes that will occur with the next increase in knowledge level. We could also be prepared for the downward times of integration and not squabble over the causes for the decreases and spend time, energy, and money looking for solutions to problems that will eventually solve themselves or are actually signs of growth to come.

This is originally where this project began, with the article about the politicians squabbling over a downturn in education. If those politicians understood that downturns were a necessary part of our development as society, that those downturns gave our society a chance to catch up and integrate new knowledge levels into our lives, they would not waste so much time and energy arguing and appointing committees to study the problems. They would instead devote that time and energy to decreasing the negative effects of the decreases and helping our society to understand, integrate and prepare for the coming increases.

The other benefit of understanding and using the societal learning cycle is the benefit of continued movement. Although continued movement without proper preparation can create problems, movement with proper preparation can be very beneficial to our society. Continued movement could help to fulfill our need for self-actualization and give us the rewards that were identified as motivating forces. Many examples of these benefits exist in our society today. Everything, from fire to lasers, from language to love, from safety to self-actualization, has resulted from our movement to higher levels of knowledge on the societal learning
cycle and in turn has given us rewards of many kinds.

Conclusion

The societal learning cycle that I have proposed is developed from the curves and cycles of individuals and businesses, and it reflects the nature of both in our society. The societal learning cycle, however, represents much more. It affects nearly everything in the world as we know it and its possible implications are mind-boggling. Further research must be done to further prove its existence. My proposal of the societal learning cycle's nature and its motivating forces, as generalized as it is, should be enough to warrant further research. The benefits that could result from the existence of the cycle and the problems that could result from not understanding the cycle are too great to ignore.
References


