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An Introduction to Engineered Learning

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Abstract
This monograph summarizes a forthcoming book on Engineered Learning. The book will describe a learning model that predicts the outcome of corporate learning events on both an individual and group basis.

This article provides a useful overview of the learning model. The model is founded on the principles of Organizational Engineering. However, the learning model extends many of these principles into new areas.

AN INTRODUCTION TO ENGINEERED LEARNING

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INTRODUCTION

Engineered Learning is a new way to improve learning. It advances the state-of-the-art by targeting corporate learning. It solidifies this position by including prediction on both an individual and group level. In other words, it seeks to foretell the outcome of a learning session before that event begins. This means that taking action to prevent problems and optimize learning becomes a viable strategy.

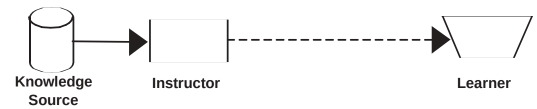
Realizing this objective requires breaking new ground on several fronts. The technology incorporates a learning style model that is able to handle both individuals and groups. It considers motivation in several dimensions. The structure of the subject matter being taught is a variable whose structure can be changed. These and other advances give Engineered Learning a new perspective. Understanding how this is done begins with understanding the model.

I. WHY "ENGINEERED LEARNING"?

Learning is an engineering issue

Engineered Learning sees learning as a transmission issue. The objective is to move information from some knowledge source to a learner's brain. Graphic I is a visual illustration of the concept.

GRAPHIC 1
ENGINEERED LEARNING PROCESS



Moving content from one place to another is an engineering problem. The model is not concerned with "how" an individual learns. Its only focus is the outcome—learning. This results-oriented posture is typical of an engineering approach.

The tools have an engineering flavor

The tools used also have an engineering flavor. Theory is important only as far as it furthers model design. Science is a tool, not a God. It is used where it is needed. Mathematics is limited to where it helps get desired results or where it is needed to communicate. Aesthetics is a tool to transmit information. It is not a form of entertainment. This "nuts and bolts," practical approach also reflects an engineering perspective

The objective is practical outcomes

Finally, Engineered Learning looks for results. It is not enough to "feel" that it is working. The results must be seen and be objectively verifiable. Predicting the results by each individual learner makes this possible. Any interested party can test the outcomes. This "let's see it work" stance is also typical of an engineering attitude.

The match between a typical engineering approach and the methods used in this model give rise to the name—Engineered Learning.

II. THE MODEL BY ANALOGY

Learning is a transmission problem. Content moves from a knowledge base to an individual brain. The result of this process is a tangible result—learning. The design of the model focuses on improving this visible outcome.

The model is like an Internet message

The best model analogy is a broadcast Internet message transaction. The transmitter (i.e., instructor) places content into a message. This is independent of the medium—the message can be anything. Similarly, the content of a learning event can be anything.

Message "language" must be compatible

Since the transmitter's purpose is successful receipt, the formatting of the message transmission is an issue. The message structure must be compatible with the receivers (i.e., learner's) browser. Sending a picture to a browser without graphic capability results in a loss of information. Expressing the visual information in words might improve the outcome. The learning model captures this aspect of learning in the alignment of content and learner profiles. The better the alignment, the more sure you can be that the message will be received.

The transmitter (i.e., instructor) matters

The alignment of the content and learner profiles can be affected by the transmitter (i.e., instructor) itself. The transmitter may not have the equipment necessary to sense the kind of browser the receiver (i.e., learner) is using. In that case, the default assumption is that the receiver's browser is the same as the transmitter. The success of this strategy will be a matter of chance. Some may get the message while others may not. The learning model captures this in the alignment of the instructor and learner's profile. A poor alignment tells the instructor that his or her "natural" approach is not ideal for the situation at hand.

Receiver sensitivity can be heightened

If the message is important, the transmitter might want to tag the message with an "urgent" notation. This increases the likelihood that the receiver (i.e., learner) will pay attention to and absorb the information in the message. This parallels the motivational part of the learning model. Motivation effectively heightens the sensitivity of the learner (i.e., receiver).

Environmental distortions exist

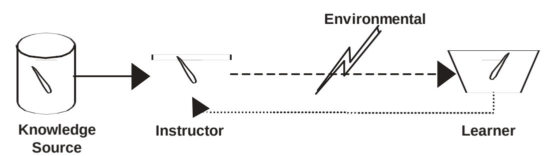
Sophisticated transmitters are able to sense the quality of the line and select the best available. A poor quality line can garble the message. The receiver may receive something but it can be difficult or impossible to decipher. This is an environmental factor. It is something that is independent of both the transmitter and receiver. The learning model includes one of these potential distortions. It is the mix of learners participating in an event. Differences between learners can introduce "static". As with a poor quality line, this can interfere with the communication between the instructor and individual learners.

Model success can be measured

Finally, if the message is important, the transmitter might request receipt confirmation. If successful, there is no need to re-send the message. In the model, the predicted rank ordering of learners fills this role. Using this, the transmitter (i.e., instructor) can confirm that the transmission met its expected objective. This may not be 100% success. It may be 70%. However, whatever it is, success is measurable.

Graphic 2 updates the basic model. There are now dials on the major components. The model now recognizes potential "line" interference. A feedback loop is available for quality assurance as well as "fine tuning."

GRAPHIC 2
EXPANDED ENGINEERED LEARNING PROCESS



Engineered Learning is a system

The Engineered Learning model is a simple system. Comparing predicted behavior to actual outcomes provides a feedback loop. This means that an ability to assess the ongoing accuracy of the system is "built-in". The structure of the model allows other factors to be "plugged in" if needed. In total, the Engineered Learning model offers benefits that are worth pursuing.

III. A GUIDING PERSPECTIVE

Information Processing is the guiding paradigm

Engineered Learning rests on a simple fact. All knowledge, except that given by biology (instincts, etc.), depends on the how a person processes information. To grasp and retain new knowledge it has to make sense in the world that the learner lives.

For example, think about Certified Public Accountants. Their world is one of organized relations and demanding logic. The objective is outcomes of high certainty. A highly committed CPA is likely to generalize this view to the world outside of accounting. Such a person would likely reject fragmented, unstructured information surrounded by high uncertainty. For the CPA, the "right" way to teach is a logical, methodical, detail sensitive approach.

Now, think about stock market "day traders". These people make a living buying and selling stocks on almost an hourly basis. They try to capitalize on small price fluctuations that happen without a visible "reason." They have to move decisively, even when they are not sure of the wisdom of a decision.

People have different preferences

Like CPA's, successful day traders are likely to generalize the approach that is successful in one area to others. They are likely to see value in being able to work with minimum detail. They probably will not search for certainty. The logic demanded by the CPA is likely to appear excessive. It is a different worldview. It results in different information processing requirements.

Knowledge can be framed to meet any preference

Knowledge itself is indifferent. Most (but not all) knowledge can be set in terms comfortable to either the day trader or the CPA. For example, you can teach computer programming by trial and error—minimum logic, high action and uncertain outcome. Alternatively, you can begin with theory, proceed through methods and end up with coding. The result is the same. Either strategy can produce people able to program a computer.

Groups, not people, are taught

Most of the time you can mix and match strategies. For example, you can use some theory and some practice. The trick, of course, is figuring out how much of each to use. In typical corporate situations, you have to do this for a group of 10, 20 or 30 people—all at the same time.

Each learner can have unique preferences

Further, each one of the people in the group probably has a unique mixture of preferences—varying amounts of this approach and that approach. To be fully effective, a learning model must be able to recognize the needs of the group as a group. It must be able to address the unique mixture within each person and still be able to distill an overall commonality.

Engineered Leaning handles both individuals and groups

Engineered Learning addresses this problem using an engineering perspective. Its goal is to maximize the amount of information transferred in total. In other words, the more units of information transferred the better. This can mean shortchanging some people in order to let other people learn more. However, the model tells you who is being shortchanged. This means that "on the side" remedial action is available if desired. However, it rejects the need to sacrifice the good of the many for the good of the few.

Engineered Learning also characterizes the knowledge content in the same terms as used for people—a profile. A calculation of the overlap of these profiles describes the degree of "fit" between the content and the learner group. The same process applies to matching the instructor and learner group.

Preference distributions provide consistency

Estimating the interaction effects between class members also uses profiles as a basis. In all cases, the higher the overlap, the easier (and more likely) the knowledge will be acquired. The consistency of approach provides a uniform theoretical stream that runs through these elements of getting information to the learner.

The goal: maximize information transfer

Adding in motivation and combining all of the above elements into a model provides an index of how well a learning event is setup for achieving maximum information transfer. If it does not meet an instructor's threshold, the instructor can act to improve the likely outcome. Engineered Learning gives "before-the-fact" guidance. Its focus is on improving learning outcomes, not just explaining them.

IV. AREAS OF APPLICATION

Models are theories put into practice. The design of a learning model can depend on its area of use. These areas come in all forms. For example, Guthrie's classical model was most used in animal studies and personality disorders (Guthrie, 1938). Skinner found play in clinics and classrooms and rejected its use in learning theories (Skinner, 1950). Gardner's multiple intelligences is most used in child development. However, he has attempted to extend it to areas like school programs (Gardner, 1993).

There are many models because there are many needs

Finding a niche can also perpetuate models. The Adult Learning Model (Cross, 1981) is specifically aimed at adult learners. Price Systems sells the Dunn and Dunn (1978) model that appears to be targeted at schools (Price Systems, 2002). Other models such as the GOMS targets computer learning skills (Card, Moran, & Newell, 1983). The military tends to favor experiential (Rogers, 1969) or social models (Bandura, 1971). Even areas such as mathematics and medicine favor specific theories and models (e.g., Park, 1975). One reason that there are many theories and models is that different places have different needs. There is no "silver bullet" able to serve all of these areas.

Engineered Learning is designed for corporate use

The design of Engineered Learning addresses the needs of corporations. Its intent is to handle short duration, event-based activities. Its focal point is knowledge transfer activities that support organizational goals. These efforts are typically courses, seminars, workshops and other event-based experiences. While Engineered Learning may apply more broadly, the interest of the authors centers on this confined area.

Personal privacy is essential

Targeting the model to corporate interests imposes some limits on what can be included. First, the data obtained from learners had to be non-intrusive. The audience is adult employees. The firms interest in them goes far beyond any single event or group of events. It also extends far out in time. The developers could not use anything that a learner might judge as an invasion of privacy. The criterion was appearance and not substance. For example, "introvert" is not technically a negative. However, it is a negative in the popular mind. This is enough to bar theories relying on this (or similar) classifications from use. Engineered Learning must use inherently benign tools.

In corporate models cost is a concern

Information input had to be quick to obtain. In one- and two-day events, minutes matter. Fast, easy-to-complete forms were required. Engineering is concerned with cost as well as outcome. Filling in forms is a real cost when the firm is paying everyone in the room. In addition, the more questions asked, the more likely it is that someone will consider them an invasion of privacy. Brevity matters. The input for the Engineered Learning model requires less than 10 minutes of the learner's time.

Fast Response is a requirement

Response must be fast. There is no time for individual evaluations. The model needs to produce results quick enough to be useful in practice. This means that machine-based analysis is "a must." Instruments and methods requiring individual evaluation are useless in this situation. The Engineered Learning model addresses this by making the model entirely mechanical.

Verification is mandatory

The model output also has to be verifiable. Corporations engage in many activities. They involve many audiences. The instructor must have a "built-in" ability to gauge the accuracy of the model with specific learner groups. The goal is a practical tool that works were it is used. Building in prediction gives Engineered Learning this ability.

The model is a tool

Like most other models, Engineered Learning has a "niche". It is a tool designed for a purpose. That purpose is corporate training programs.

V. POSSIBLE BOUNDARIES

The development of Engineered Learning focused on training activities. This is "specialized instruction and practice" (American Heritage Dictionary, 2000). The authors see training as learning that minimizes abstraction. Instead, it favors practical applications in specific areas. It is enough that the learner be able to apply the learning in a specific context. The depth of understanding is a bonus.

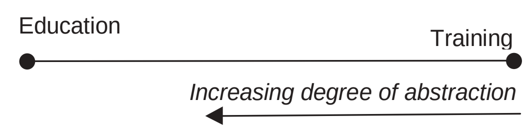
Learning Content has degrees of abstraction

The authors see learning as a continuum running from the highly specific at one end and highly abstract at the other. A child learning to count illustrates the lower end. Example and repetition usually using the child's fingers become a way of making the counting process real. Using this knowledge, a learner can make comparisons of quantity. His or her life experience is improved. This type of learning represents the low-end anchor of the learning continuum.

Teaching algebra is at the other end of the continuum. Factoring an equation is a process that is applied to another process (the equation). It is at least two steps away from anything specific. This learning is general. It applies to anything that can be represented by an equation. Education is the term that we apply to this type of generalized learning.

Graphic 3 is the authors' view of learning as a continuum with infinite degrees of gradation. Exactly where training ends and education begins cannot be defined. There is no universally accepted metric for abstraction. The reason for drawing the distinction is that Engineered Learning focuses on the training end of the spectrum. It may work at the other end. However, the authors did not address this in development or testing.

GRAPHIC 3
EDUCATION AND TRAINING CONTINUUM



Content can be framed in either context

Note that the content does not determine the position on the continuum. You can teach computer programming by example. You can also teach it by moving from theory, through method to practice. It is the arrangement that you apply to content that determines whether it is training or education. Content itself is not a limitation of the model.

Engineered Learning is for adults

A possible limitation of the model is the age of the learner. The "I Opt" tool that lies at the core of the model has been well tested and verified with adults. It has been applied to children down to the age of seven. However, the evidence for effectiveness at this age is only antidotal. Practically, confining the model to use with adult learners is a prudent course.

Engineered Learning focuses on training

There may be other boundaries. However, these are the principal ones. The authors did not attempt to create a "single solution" able to address all learning in all situations with all audiences and involving all contents. Rather their interest is to improve outcomes in the dominant form of learning in corporate environments.

VI. WHERE IT FITS

Learning theories fall into classes by the approach they share. Information processing theory, behaviorism, social and personality are only a few. Many others can be found using any search engine.

The model is multi-dimensional

Depending on focus, Engineered Learning could fall into a number of categories. Its best classification is as a multi-dimensional model. This would put it in the same group as the models of Dunn and Dunn (1978) or Keefe (1989).

These models are typically sensitive to individuals and use items drawn from different areas. For example, a survey based on Dunn and Dunn's model (Price, Dunn and Dunn, 1990) captures environmental, emotional, sociological, physical and psychological factors.

However, sharing a class does not mean the models are the same things. These other models have their uses but they are not substitutes for Engineered Learning.

VII. THE ADVANTAGES IN DEPTH

The outline of the model suggests some of the advantages available from the new approach. However, there are many theories. The Theory into Practice database summarizes 50 creditable learning models. There are many more not in the English language or not widely enough accepted to be annotated (Kearsley, 2001).

With this wealth of material available, why add a new theory of learning? Could not an existing theory be modified to meet the objectives? The answer is no. Following are some areas where the model offers unique advantages.

a) Content

Some theories acknowledge content

Many current theories address the subject being taught—the content—in a somewhat indirect fashion. For example, traditional approaches like Kolb's Learning Styles Inventory (Kolb, 1985) focus on a procedure. This procedure offers a way of addressing various learning styles without knowing exactly what they are in a particular group.

Kolb is not unique. Many of the fifty theories in the Theory Into Practice database (Kearsley, 2002) offer insights into learning. Some have even tried to measure content (e.g., Felder, 1996) but stop short of matching this to the group being instructed. In final analysis, content-the subject matter being taught—is treated more as a "given" than a variable.

Content is a variable that can be adjusted

Engineered Learning takes a different approach. It deepens the understanding of content. It shows how to measure its structure. It goes on to show how this structure aligns with human learning preferences. Adjusting content to optimize the learning of a specific audience becomes possible. This pushes the boundary of understanding forward into the area of definitive guidance.

b) Measurement

Measurement involves mapping data to the categories of a model. Most theories say that people have capacities in all directions. For example, the Herrmann Brain Dominance Instrument sees people as governed by four instincts—emotional, analytical, structural and strategic (Herrmann, 1990). While emphasizing a dominant preference, a person has at least some ability in all of them.

Most models acknowledge multiple capabilities

Other models tend to view their categories the same way. For example, MBTI theories offer categories like "feelers" or "introverts" (Lawrence, 1994). Everyone must have some "feeling" and "introversion" to conduct life. Howard Gardner's Multiple Intelligence identifies seven types of intelligence. One may be dominant. However, Gardner notes that "every normal individual possesses varying degrees of each of these intelligences" (Gardner, 1993).

In practice most models stress dominant styles

Other learning theories also call for a capacity in all directions. However, the use of these theories seems to tell a different story. Attention to less dominant styles is usually acknowledged but ignored. Rather, a single dimension is typically used in field situations. The recognition of multiple facets does not appear to translate well into practice.

Engineered Learning captures all dimensions at the same time

The Engineered Learning is different. It measures the degree of preference in each of its categories. It then goes a step further. It shows how the facets of the model interact with each other. The result is that all of a person's abilities are considered at the same time. This means the model can leverage all of a person's capacity—not just a dominant one. This allows the instructor to tap into more of a person's capacities.

c) Groups

Categorical tools are individually useful

The measurement used in existing models tends to be categorical. They are able to say that a person is a highly committed introvert. Or that they are strongly strategic in approach. This is useful on an individual basis. Knowing this allows an instructor to adjust the delivery to better support a particular learner.

Most models do not handle groups well

Unfortunately, it does not help much when working with groups. It is difficult to meaningfully "add up" mild introverts with strong extroverts. Exactly what happens with a particular mix of types is a bit vague. The same applies to the Brain Dominance model. Trying to combine people using different approaches is extremely difficult and possibly futile.

Most training is given to groups

The character of a group is important. It directly influences the practical use of any model. Training Magazine surveyed corporations. They found that 77% of the instruction was given in classroom-like settings (Galvin, 2001). The American Society of Training and Development puts the percentage at 79.4% (Van Buren and Erskine, 2001). Models that cannot accurately typify a class will be of limited value in corporate settings. Individuals are important. However, an instructor has to teach a class as a whole if they are to succeed

Engineered Learning can handle groups

Engineered Learning uses a tested method for combining people into groups. The "I Opt"™ method has been used by tens of thousands of people. Use in thousands of groups also shows that the method is reliable and accurate. A formal validity study (Soltysik, 2000) testifies to the truth of these statements. The methodology is reliable and accurate in representing group preferences. This is a move forward in addressing the real subject of the instructor's effort—the group.

d) Theory

The foundations of many theories of learning seem to find their basis in intuitive knowledge. We sense a level of truth but cannot pinpoint exactly why it is true. For example, the basis of the Herrmann Brain Dominance theory is "instinct." There is no reasoning offered on how these "instincts" arise. They just are.

Most theories are vulnerable

Other learning theories are, to one degree or another, in the same position. For example, many of the theories derived from Jung (Jung, 1934) are based on the assumption that personality is divided into four dimensions. Again, no reason on why there are only four. It just is. Five or six are equally possible. If any are added, all of the work based on the four-quadrant model is threatened. Many learning theories rest on Jung's work—directly or indirectly. These theories can be subject to a vulnerability built into their foundations

Engineered Learning is stable

Engineered Learning is different. It starts out with a single assumption—all humans are information processors. The four-quadrant model it uses logically follows from this assumption. There cannot be any other number. This means that greater faith can be put into the "reality" of Engineered Learning. Its categories are not assumed. They are the logical outcome of people being information processors.

e) Validity

At the basis of many learning theories is an instrument. This is a tool (i.e., test, survey, research method, etc.) that measures something. Validity is the estimate of how good that measurement is.

Technically, validity is the best approximation of the truth of a proposition (Trochim, 2002). In other words, a proposition might be that the DISC instrument accurately measures "dominant" personality (Marston, 1979). If DISC is valid, you could say that this proposition is true.

Trochim goes on to define eight statistical tests. These cover all of the bases (face, construct, content, convergent, discriminant, concurrent, predictive and conclusion validity). Reliability is not a measure of validity but is usually bundled into validity discussions. That makes nine measures that have to be satisfied to be "really" sure. If a theory only meets two tests, you may still have an 78% chance (2 tests divided by 9 available tests) of invalidity.

Instrumentation is validated across all nine validity dimensions

Engineered Learning uses the "I Opt" Survey. This tool meets all nine of the measures of validity. It did this at the academic level of significance or better (Soltysik, 2000). In other words, there is a 95 out of 100 chance that the validity statements are right. In most cases, the tests came out at a 99 out of 100 level. The scope and depth of this validation sets a new standard for the field. These results again push forward the boundaries.

f) Prediction

Prediction is the ability to foretell an outcome before it has occurred. The ability to predict increases confidence that a theory really matches the way the world works.

Prediction is a difficult objective

Prediction is a difficult objective. Many theorists attempt to escape the issue by claiming that "understanding" is the important goal. Their focus tends to be descriptive. This difference is big. It is the difference between telling you what a car looks like and giving you the car to drive. Which would you prefer?

Prediction is different from validity. A theory can be "valid" and be unable to predict anything. Further, it can be valid in some circumstances and not in others (Maxwell, 1992). In other words, a learning theory may be "validated" and not work in the situation you are applying it.

Prediction means a model can be continuously validated

Engineered Learning builds prediction into the model. It predicts the learning of students on a rank order basis. It does this each and every time it is used. For example, it will predict that Mary will place ahead of John in class outcomes. Prediction means that an instructor can "test" the learning model every time it is used. Simply check to see if the rank order held true. If it did, confidence that the model is working increases.

Prediction can improve outcomes

Prediction can also improve outcomes. The model predicts using factors that are controllable. Variables in the "formula" can be adjusted to get a new predicted result. This means that different strategies can be compared. With this knowledge a learning event can be "fine tuned" to yield an optimal outcome.

That is not all. Prediction is by participant. You can see who will benefit and who will not. While a strategy may give the best overall outcome, certain people may be disadvantaged. Knowing who they are opens the possibility for remedial action. For example, it may be possible to provide extra support. At minimum, the effect of teaching strategies is known in advance.

Prediction can improve the status of the field of learning

Engineered Learning moves the field closer to the standards of the hard sciences. The use and further development of Engineered Learning can reasonably be expected to improve the status of the field relative to other professional and academic endeavors.

g) Flexibility

Most learning models use a universal formula

Many (but not all) learning theories prescribe one way of doing things. For example, Knowles' Andragology theory says that all adults favor a specific approach. They need to learn experientially. They need to know why the subject is relevant. They all want to use a problem solving method. Their focus is on subjects of immediate value (Knowles, 1975). Regardless of who they are, this is what they need.

Kolb's theory is also a universal solution. Cycling through (1) reflection (2) conceptualization (3) experimentation and (4) experience covers all the processes used in learning. The learning cycle applies to every new concept regardless of what it is, who the students are or which subject is being taught. Cycling through all of the stages insures that all bases are covered. However, the theory offers limited guidance on how much effort should be invested at each stage.

Many models have similar universal formulas. The Engineered Learning's "formula" attempts to advance the state-of-the-art through flexibility. The model does not impose one path. Rather, the instructor designs a strategy that meets the specific learning situation. The only prescription is to maximize information transfer. This flexibility is not aimless. It exists within a framework that acts as a compass. The "North Pole" of the compass is improved learning performance.

Engineered Learning is flexible

Most learning models enhance learning. Kolb's theory increased the effectiveness of engineering education. Herrmann's theory improved performance and attitudes (Felder, 1996). There is general improvement in all cases. Engineered Learning also works. However, Engineered Learning introduces more room for human judgment. This judgement can be used to better meet varied learning situations. This flexibility facet of Engineered Learning can again help advance the state of the learning art.

h) Improvement Opportunity

The Engineered Learning model has interlocking component parts. All of the parts can be improved and enhanced. As knowledge accrues, new parts can be added. Existing parts can be modified. The relationships between the parts can be redefined. The opportunity for improvement abounds.

For example, current learning models do not make a provision for coalitions. Coalitions are a natural condition that arises when people see things the same way. When people in a coalition interact, they tend to reinforce each other. This can cause them to state their case with vigor. This, in turn, can translate into a bias within a classroom.

The theory used by Engineered Learning has methods for finding and controlling these clusters. Coalitions are usually visible at a glance. Engineered Learning can identify many other crosscurrents in a classroom. If these influences can be expressed mathematically, they can be included in the model. The possibilities for extending the reach of Engineered Learning are endless.

Most existing theories grow within boundaries

Other theories also have an ability to improve. For example, Multiple Intelligence Theory leaves open the option of adding to the original seven (Gardener, 1983). There could be an eighth. Or a ninth. Or a tenth. Only logic is needed to make these additions. The only condition is that it has to stay in the defined frame. It has to be an "intelligence."

Engineered Learning growth is less confined

The difference with Engineered Learning is that it is an open system. It has a learning style component. It also has motivational and social elements. Its structure will allow the addition of more different components Gardener's theory (and others like it) can grow within a tight frame. Engineered Learning grows without being confined.

i) Overall Benefit Statement

The benefits are numerous and substantial

Engineered Learning introduces new areas not well treated in existing models (content and prediction). It upgrades measurement by moving from categories to unit measure. It rests on a stronger theoretical foundation. It is more completely validated than earlier models. Its increased flexibility gives it greater adaptability. Finally, the model encourages growth and improvement.

Engineered Learning offers many things. The promise of these benefits makes it a useful addition to the field. It is an investment promising high returns.

VIII. A BRIEF SUMMARY BY CHAPTER

Chapter 1: A Primer

Engineered Learning borrows from established theory

Chapter 1 is a primer. It outlines the theory used by the model. Its source is Organizational Engineering (Salton 1996, 2000). Engineered Leaning borrows heavily from this earlier work. However, it modifies the orientation.

Organizational Engineering is oriented toward the future—what will happen if particular people are combined in a particular way? Engineered Learning runs this backwards. It looks at the factors needed to support a particular profile. It then goes on to provide the new knowledge in a way that a person maintaining that profile will find acceptable.

The primer is not complete

The primer is not a full elaboration of the theory. For example, it does not cover all of the assumptions and details. It errs in favor of simplicity. The objective is to provide a scaffold for Engineered Learning. Those interested in getting a full command of the theory must go to primary sources.

Chapter 2: Motivation

The receiver (i.e., learner) has to be "turned on" for any learning to occur. The more "power" available, the more likely it is that the learner will acquire the new knowledge. A gauge of the energy available is termed "motivation."

Motivation has a rational part

Motivation comes in two forms, rational and emotional. Both can power learning. One form of motivation is rational. This is the motivation people can explain in regular conversation. The cost of a learning event is "deducted" from the expected benefits. A positive result produces an incentive to learn. A negative result produces avoidance, frustration and dissatisfaction. In both cases the "reason" for the outcome can be "explained."

Motivation also has an emotional part

The second form of motivation relies on emotion. It relates to the bodily state of the learner. Emotional motivation is an overarching tone that colors the intensity of ALL rational processes. One of these processes can be rational motivation.

Motivation can be calculated

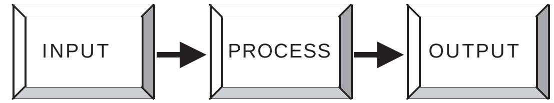
Chapter 2 outlines a strategy for measuring the energy available at a particular learning event. It considers both emotional and rational energy. It goes on to offer prescriptions that can influence the level and direction of the energy available.

Chapter 3: Profiling Knowledge

The amount of energy needed to learn depends on the nature of the transmission. The better aligned the transmission is to the receiver, the less the energy that is needed to acquire and process it.

The basic information-processing model controls the "setting" of the receiver. This is the traditional model that has been extensively used in multiple disciplines. Graphic 4 shows this basic model.

GRAPHIC 4
INFORMATION PROCESSING MODEL



Information flow is guided by known principles

Engineered Learning modifies the basic flow diagram by adding components that are unique to humans. The concept of "method"—the organization of data entering the cycle—controls human input. "Mode" is a concept governing the likely output. Mode can range from action to thought. "Process" is the connection between method and mode. It governs the integration of the behavior generated by the input and output parts.

Humans have input and output preferences

Every human has a preferred strategy for accepting information input. Some of us prefer detail while others prefer to focus only on central elements. On the output side, some of us favor mulling over issues while others tend to move quickly to action. Over time, these preferences imbed themselves. They become the "right" way to do things and—for a particular individual—it is the "right" way.

Content structure affects learning

It is impossible to embrace the whole range of "method" in a teaching situation. You cannot offer material in completely structured and unpatterned formats at the same time. The same is true for output (mode). You cannot orient information toward pure thought and instant action at the same time. The learner (i.e. "receiver") is set up to handle a particular mix of method and mode. If the content is not aligned with their preset they have to work harder (i.e., use more energy). The harder they must work, the less likely the transmission will be successful.

Content structure can be matched to learner preferences

Chapter 3 shows a way of reducing content to a graphic that has a mathematical meaning—a profile. The structure of the profile is directly comparable to "preset" human preferences. The greater the degree of match, the easier it will be for the learner to process the content. The easier it is to process, the more likely the learner is to get a command of that content.

Chapter 4: Instructor Effects

Instructors are "transmitters." They send the information from its source to its destination. However, they do much more than a simple transmission. They choose what content is to be transmitted. They can also reformat it. They can elaborate or abbreviate. They can omit or enhance. Whether they know it or not, they determine what is to be learned as well as how well the subject is learned.

Instructors "bend" content

Like most people, instructors have favorite ways of processing information. Like everyone, they tend to assume that their way is the right way. Regardless of the subject, instructors can always accent or moderate different parts of the content. In this process, they tend to "bend" content in favor of their own preferences

"Bending" depends on skill levels

The degree of the bending depends on the instructor. The more professional the instructor, the less "bending" is likely. Inexperienced instructors must place a greater reliance on their "natural" tendencies. They are more likely to "bend" things without knowing they are doing it. The professional has access to more tools and has a greater sensitivity. They are more likely to use professional judgement rather than "instinct".

Optimal delivery depends on the instructor and class

"Bending" content in the direction of personal preference is one instructor effect. The delivery of the content is a second. For example, a group of learners might prefer methodical, coherent, measured communication with a minimum of emotional overlay. The instructor may favor rapid delivery, use of broken streams of logic and include emotion (i.e., variation in voice, exaggerated body language, etc.) as a way to give emphasis or convey conviction.

Instructor-group mismatches affect learning

The instructor and participant will "hear" each other in a misaligned situation. However, the mismatch between the instructor and the class has an effect. The instructor will be "exhausting" the learners. Misaligned communication forces participants to convert content into a form that they are capable of processing. This is an added cost of learning. The economic law of supply and demand applies. The greater the cost, the less will be "sold."

The instructors' strategic preferences thus affect learning in two ways. It can affect the "structure" or design of content. It also affects the transmission itself.

Instructor effects can be measured and controlled

Like learners, instructors have imbedded profiles. The effect of this profile will vary by skill and preparation. However, an effect will almost always be present.

Chapter 5 shows how to compare an instructors profile to individual learners and to a learner group as a group. It also describes strategies that an instructor can use to control alignments.

Chapter 5: Calculating Alignment

The content and instructor effects are gauged by overlaying their profiles with that of the learner. The overlap between the profiles shows the degree of structural match. The location of the overlap shows the specific areas where the compatibility is more or less pronounced.

Alignment effects on individuals is easily seen

On an individual basis, the implications of an overlap are clear. Simply look at how much overlap there is and where it falls. The higher the overlap, the greater the ease of learning. The more overlap in a given quadrant of the model, the more likely it is that the processing preferences in that quadrant will be used to acquire the knowledge.

Group effects are harder to see

The same principles hold true when estimating the composite characteristics of a group. Profiles need to be consolidated to identify the area common to most members. Chapter 5 shows how this to do this and how to interpret the results.

Some people will always be "shortchanged."

Any strategy for optimizing a group will always result in some people being "shortchanged." These people fall outside of the area common of most members. The chapter outlines how to identify people with this exposure. It then goes on to offer some suggestions for actions that can help lessen any learning shortfall.

Chapter 6: Interaction Effects

Participant interaction can effect learning

A majority of training occurs in group settings (Galvin, 2001, Van Buren and Erskine, 2001). The human dealings in these group settings can affect learning. They can either ease or disturb it. For example, isolation or acceptance can affect the rational and emotional motivation of a person. This is not central to the learning process. However, interaction has influence.

Other theories recognize social effects

Other theories have social factors at the center. For example, Lave focuses on social context (Lave, 1988). In this theory, the learner becomes part of a "community of practice" that contains the beliefs and behaviors to be learned. The learning just happens rather than being directed. There are also other theories that draw on interaction as a central component. Bandura's Social Learning theory (Bandura, 1971) is one. Vygotsky's Social Development theory (Vygotsky, 1978) is another.

Social theories have limits in corporate environments

Social theories have their limits. For example, it takes time to develop Lave's "community of practice". Corporate training efforts typically last only for a day or two. Bandura's theory depends on observing and modeling. While this may work, not every subject is well suited to the strategy. These theories do provide loose direction. They do not provide exact guidance. They tend to be less than ideal in corporate training efforts.

Engineered Learning sees interaction structurally

Engineered Learning sees interaction structurally. People sharing a learning style will tend to find each other compatible. The learners are talking the same language. Their common viewpoint means they are likely to find each other's judgement to be agreeable

Class members whose learning styles do not mesh with others can have a difficult situation. For example, some participants may use a different horizon or be more detail sensitive. These people may be socially overlooked as others seek out people who "talk their language." During the class sessions the "out of phase" people can have trouble getting their viewpoint addressed. Social discomfort, less reinforcement and less attention to their preferred style can take a toll.

Learning exposures can be identified

Engineered Learning sees interaction as material. However, it is environmental. It is not in the direct stream of the transmission. Rather, it sits off to the side. From that position it can clarify or distort the learning with equal ease. It merits attention. Chapter 6 describes graphical and numeric tools useful in estimating its effects. The chapter also outlines steps the instructor can take to influence this model component.

Chapter 7: The Model

This chapter puts all of the components together. The model uses a linear equation to estimate the probable

effects. Discriminant analysis generates the coefficients attached to each variable. The result of this equation is an index of learning.

Prediction can guide instruction

The model produces both predictive and diagnostic information. The outcome of the model is an index of probable learning by a person. This provides the instructor with an indication of the likely success of teaching the course as planned. If the overall level is adequate, the instructor need only proceed. If it falls short of the instructors' standards, an instructor can act to improve the likely outcome. The diagnostic capabilities of the model can be useful in guiding these actions.

Diagnostically, each variable provides information that can help guide instructor initiatives. For example, assessing the overall structure of the rational motivation component can alert the instructor of the need to invest time in outlining potential benefits. By assessing each component of the model, the instructor is given options on the areas where effort might be directed.

Corporations invest a great deal of money in training. Using a model designed to improve learning outcomes helps give assurance that there will be a return on that investment. In addition, training is becoming ever more central to the success of a company. This promises to continue well into the future.

Technology will continue to increase the need for hard and soft skill training

The concept of "technological lag" says that adjustments in human systems lag changes in technology (Veblen, 1904). Technological changes are compounding themselves at an ever-increasing rate. The computer will probably continue to generate change through the foreseeable future. Robotics, remotes sensing and communication options are only a few areas of likely change. The book of DNA is only cracked. Space travel is in its infancy. New knowledge is being generated in every quarter and its rate of dissemination is accelerating. If society is to absorb these dislocations, an ever-increasing level of training will be needed. Training's role in smoothing this adjustment is a key to survival.

Using the model to optimize outcomes can be an important contributor to overcoming technological lag. It can improve the results of each program to which it is applied. Cumulatively this means that firms using the model can get a long-term competitive advantage. At its core, the model is a business tool.

The model is a business tool

The goals of Engineered Learning are worthy. However, it is not the final answer to all training issues. It does not consider all of the factors involved in learning. Even the variables it uses are imperfect. Its measurements are inexact. The combination of incomplete specifications and inexact measures mean that the results of the model will not be perfect. However, the goal is not perfection. The goal is to improve learning outcomes

The model is not perfect but is useful

Chapter 7 outlines the methods and considerations for creating the final model. The chapter also includes an early report generated by the model. This information can help the reader envision the use of the tool in field settings.

IX. THE BEGINNING

There is room for development

This book is not the "last word" on learning styles and models. Rather it a first step in rethinking learning using a human engineering perspective. People skilled in instructional theory may offer revisions. Others leaning toward practice will likely see new variables. "Numbers" people will probably find better ways of estimating model variables. These contributions will improve the accuracy of predictions. In total, the usefulness of the model will improve. The authors of this book welcome and encourage these contributions.

Others are encouraged to join in the effort

The authors' intent is limited. The design of the model addresses corporate training. Within that domain the model focuses on one- and two-day learning events. It will be successful if it contributes to learning in this defined environment. This is sufficient for the authors. If others are able to improve on this, it is "icing on the cake." Like almost everyone, the authors like "icing." They encourage those able to provide it to join the enterprise.

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