(IJTBM) 2024, Vol. No. 14, Issue No. III, Jul-Sep **e-ISSN: 2231-6868 p-ISSN: 2454-468X**

Learning Curve as Effective Approach to Study Efficiency and Productivity in Business Process

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DOI:10.37648/ijtbm.v14i03.002

[1]*Received: 16 May 2024; Accepted: 02 August 2024; Published: 03 August 2024*

ABSTRACT

Learning is a process/technique increasing knowledge or skill through study or experience. Learning helps to become aware of situation/state through observing or hearing about whether it is process, functioning, operational procedure etc.. The learning curve refer as the **experience curve, the cost curve, the efficiency curve, or the productivity curve**. It is in various form increasing, diminishing learning curve how a process(Business/Operation) is improved during time due to learning and increased proficiency/efficiency. The learning curve theory explains, it is a process which helps to study the task performed is taking less time and resources used and productivity depends upon performance due to competency/efficiency as process will be learned. A learning curve is explained the rate of improvement in techniques and gives best result in production process. In business, the slope of the learning curve represents the rate at which learning new skills/knowledge add cost-savings technique in business. In this article, the focus is on to study types and application of learning curve in business as efficiency and experience effect cost and productivity respectively.

Keywords: *Efficiency; Experience Curve; Knowledge; Learning Curve; Productivity; Skill.*

INTRODUCTION

Learning Curve

The learning curve explained by psychologist Hermann Ebbinghaus in 1885 and helps to measure production efficiency and , to forecast business plan to earn profit .The learning curve is a visual representation ,as time it takes to acquire new skills or knowledge while doing some task. A learning curve is usually described by a percentage that identifies the rate of improvement in process/ technique .The steeper the slope of the learning curve , the higher the cost-savings per unit of output production .That is why the learning curve is downward sloping in the beginning with a flat slope toward the end .In Fig.1 ,is shown Average time /cost per unit depicted on the Y-axis and total output on the X-axis as in business production process proceeds.

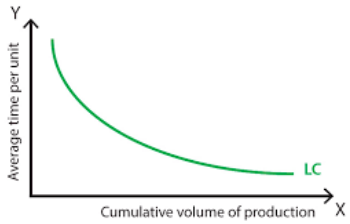

Fig 1

[1] ***How to cite the article:*** Parashar S (August 2024); Learning Curve as Effective Approach to Study Efficiency and Productivity in Business Process; *International Journal of Transformations in Business Management,* Vol 14, Issue 3, 10-18, DOI: http://doi.org/10.37648/ijtbm.v14i03.002

Calculation of Learning Curve

(i) Learning curve is measured and calculated by determining the amount of time it will take to perform a task.

(ii) A learning curve shows an improvement value to identify the rate of efficiency .

(iii) As most learners experience a learning in the beginning and gradually learn more about the subject matter . This idea is simple : the more an employee practices to do the task , the better they perform and ,in turn lower costs and higher output in the long term .

(iv) There is an initial period where the amount invested in learning is greater than the return .After learning, the return is much greater than the investment.

(v) As more employee practices a task , the better productivity lower the cost of training and higher output in time period.

(vi) The learning curve model helps to study **training progress, improve productivity, and predict learners performance and improvement over time**. As relationship between the time period spent practicing an activity, and the overall performance is not linear depends on efficiency.

(vii) In a specific periods for every activity where practice in small period would provide a more improvement in output or where even minor improvements need long hours of work . This difference in the relationship between practice and proficiency over time is known as the **learning curve.**

LEARNING CURVE FORMULA

Y = a X b,

Where: Y = average time over the measured duration(Calculated total time taken) , a = time to produce the first task , X = total amount of attempts completed (total number of tasks performed) , b = slope of the function(slope of the learning curve).

The Cumulative Average Model ,In Fig.2,along x-axis amount of attempts, on y-axis,average time per unit, The equation Y=a X b shows ,

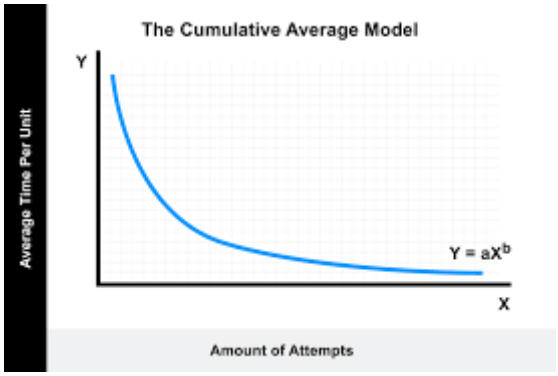

Fig 2

(a) **90% Learning Curve** -A learning curve with a given percentage indicates the rate at which learning and improvement occur. In general practice, 90% learning curve means there is a corresponding 10% improvement every time the number of repetitions doubles .

(b)**The Bottom Line**-Mostly people get better response as doing repeatedly the same task and become efficient. The time and resources need to do anything first time is probably higher ,than the time and resources spent on performing the same task for the 100th time . This idea of continuous improvement is measured through the learning curve. The

learning curve graphically or mathematically show how time spent on completing tasks often decreases over time as proficiency is increased .

(c)The learning curve can become complicated when trying to distinguish between the **cumulative quantity, the cumulative production time(T), the cumulative average production time((t)=T/q), and the incremental production time(tn-1)**.

LEARNING CURVE

Sr. No.	Cumulative Quantity (q)	Cumulative Production Time (T)	Cumulative Average Time Per Unit (t)=T/q	Incremental Time(tn-1)
1	1	1,000 hours	1,000 hours	1,000 hours
2	2	1,600 hours	8,00 hours	6,00 hours
3	4	2,560 hours	640 hours	9,60 hours

Table 1

Learning Curve data creates trend lines , and depicted graphically . In the graph , the learning curve shows that more time is needed to generate more tasks . Learning Curve shows Cumulative Production Time, Average Time per Task in Fig.3.

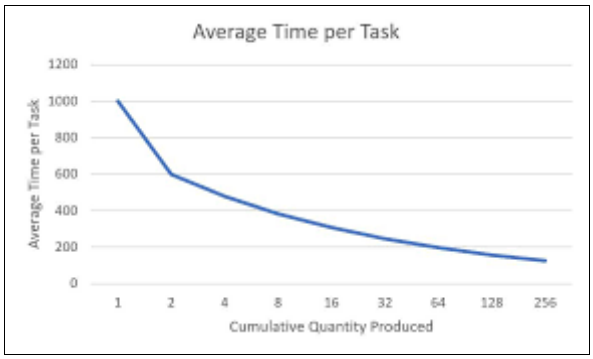

Fig 3

This suggests that the task being measured is challenging to learn and takes a certain amount of practice before an employee becomes proficient.

(a)Stage 1 – indicates a slower initial learning phase.
(b)Stage 2 – shows an increase indicating that the learner is becoming proficient in the skill.
(c)Stage 3 – indicates that the learner is increase in proficiency, once they have mastered the skill.
(d)Stage 4 – represents that the learner is still working on improving the skill.
(e)Stage 5 – represents the point at which the skill becomes automatic, memory fast for the learner.

AN EVALUATION OF TYPES AND APPLICATION OF LEARNING CURVE IN BUSINESS PROCESS

The learning curve explains cost-benefit measurement . The idea is that any employee , regardless of position , takes time to learn how to carry out a specific task or duty. The amount of time needed to produce as output increased . As the task is repeated , the employee learns how to complete it quickly and efficiently in time . It also decreases the amount of time required for a production of unit of output.

Learning Curve Theory in Cost (Cost Curve/Diminishing Returns Curve)

Cost is directly proportional to time spend on the task . It will also diminish and explained by learning curve theory through efficiency and productivity. The theory is, as a new task is learned and repeated, workers become more efficient at it , decreasing time or cost as increasing performance on that specific task. Lower learning curve percentages mean higher degrees of improvement required and the steeper the slope of graphs. In the diminishing-returns curve, the rate of progression increases rapidly at the start of learning and decreases over time.

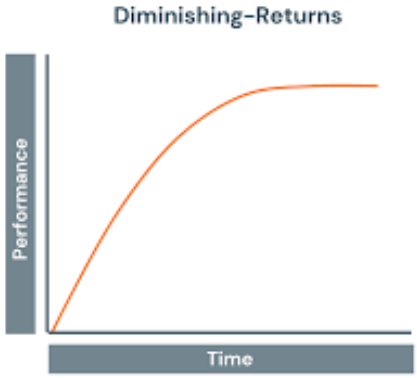

Fig 4

The above graph describes a situation where a task or activity may be easier to learn, initially resulting in a fast and rapid progression . Learning curve are more straightforward when measuring and predicting how the performance and output of the workforce will change over time , activities that follow a diminishing returns .(In terms of decision-making , the employee is performing well, but one need to keep the costs down after the initial phase).

(b) **Learning Curve Theory in Management (Experience curve)**

Organizational learning theory was developed by Chris Agris and Donald Schon in the 1970s and based on the idea that people learn from their mistakes . The process of identifying mistakes is what Agris defines as organizational learning . These two researchers popularized single- and double-loop learning . As experience increases , learning become more sharp with practice , in short run steep learning and in long run shallow curve shows moderate rate of learning.

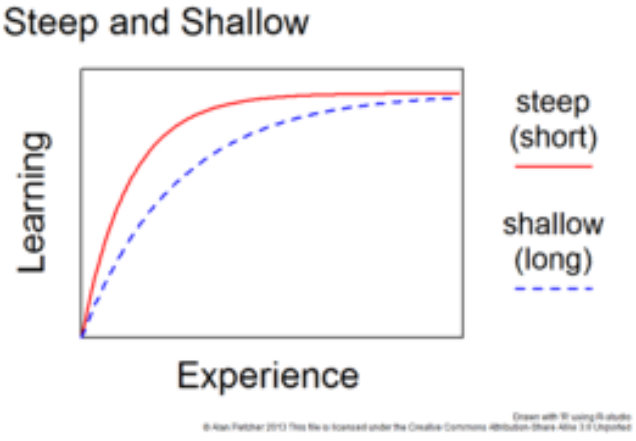

Fig 5

(c) **Learning Curve Theory in Strategic Management (Productivity curve/Increasing Return)**

Learning Curve Theory in Strategic management as more and more an individual repeats a process or activity, the more efficient performing activity in turn it decreases input costs and increase the output .In the increasing-returns curve , the rate of progression is slow in beginning and rises over time until full proficiency is achieved . As learning increases , the cost per unit of output initially decreases before flattening out , as it becomes tough to increase the efficiencies gained through learning.

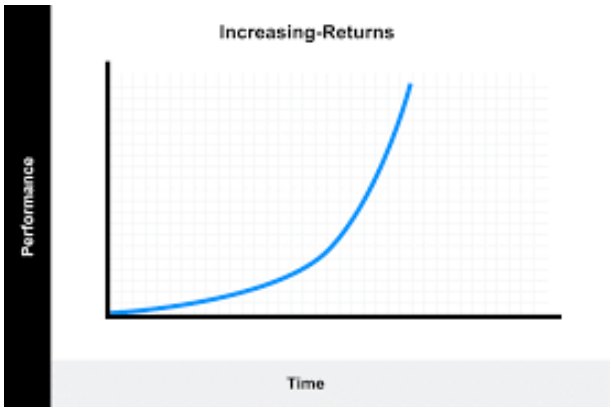

Fig 6

SPECIFIC LEARNING CURVES (SIGMOID AND COMPLEX LEARNING CURVE)

(a) **S-curve (Sigmoid Curve)**--S-curves increasing-decreasing return learning curve model is the most commonly known learning curve as the "S-curve" model. In Fig.7 , along x-axis time and in y-axis performance taken show S-Curve.

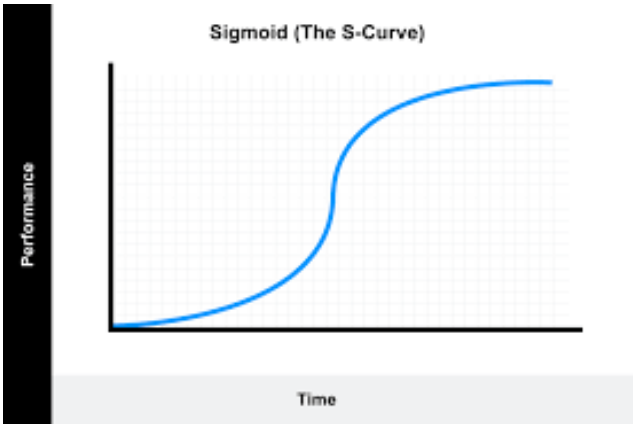

Fig 7

The bottom of this curve indicates slow learning , as a learner works to develop the skills and takes some time to do so. In proceeding phase , that the learner is now taking less time to complete a task and has become proficient in the skills. The learner's performance will increase, after which only slight increases can be expected over time.

(b) Complex Learning Curve-The complex learning curve is a more complex learning pattern and reflects more extensive tracking. In Fig.8, along x-axis time and in y-axis performance taken show Complex L-Curve.

Fig 8

This graph describes a situation where a complex task is learn with the learning rate in beginning . In terms of decision-making , no action items are required here , as the initial cost of slow learning is quickly returned upon reaching the high-efficiency phase. As the task should not take very long for employees to learn, it is taken as an indication to change employee training method .The complex learning curve shows as time goes performance effect progression in phases -**Initial Learning, Sustained Learning, Plateau Learning, Learning Refinement, and Learning Composition .**As it shows,

(a) The complex learning curve model looks different for each activity, individual, or group .

(b) Learners encounter multiple peaks and plateaus when learning tasks with complex learning curves.

(c)The learning curve model helps monitor various aspects of company performance and identify areas that need improvement. It provides insights for employee training and performance, but some limitations exist.

(d)For decision-making , have ways to improve training or reduce costs by hiring candidates who already have the experience required to reach peak efficiency for this task.

(e)A modern approach -Use of Digital Adoption Programme (DAP) for Employees to Overcome Complex Learning Curves -With a(DAP) like what flux , organizations enable employees to overcome steep learning curves that come with complex software applications and digital processes through role-based in-app guidance and real-time support.

ADVANTAGES AND DISADVANTAGES OF LEARNING CURVE MODEL

(i) **Advantages of the learning curve model**

1. **Enhanced Training and Skill Development**-The Learning curve model emphasizes continuous improvement and learning. As workers become more skilled, they also become more valuable assets to their organization ,which supports the idea of ongoing training and skill development, ensuring that employees are always up-to-date with the latest techniques and technologies in their specialize areas

2**. Risk Mitigation**-With experience, organizations identify and avoid potential risks and pitfalls, the learning curve allows to develop strategies and contingency plans based on previous experiences. This knowledge helps in mitigating risks associated with new projects or the introduction of new processes, as the organization becomes more competitive at foreseeing and managing potential issues.

3. **Cost Reduction**-As employees or processes become more experienced and efficient, the time taken to complete tasks decreases and lead to reduction in labor costs. For better understanding, to optimize resource usage and minimize waste, contributes to lower production costs.

4. **Improved Quality**-With increased experience, workers develop a better knowledge of their tasks and processes. This enhanced skill and productivity ,lead to a decrease in errors and defects, produce higher quality products or services.

5. **Predictable Performance**-The learning curve model helps in establishing predictable patterns of performance through improvement in time use . This predictability is important for planning and forecasting. Organizations with historical data to predict time taken by new employees to become proficient or for the implementation of new processes to become fully efficient.

(ii) **Disadvantages of the Learning Curve Model**

1. **Limited Applicability**-It is most effective within environments where tasks are repetitive and consistent over time. In industries or job, roles where tasks are highly effective or require significant creative or adaptive work, the benefits of the learning curve may be less pronounced. As, in artistic or research-based fields, the notion of efficiency and productivity improvement over time may not apply in the same way as in manufacturing or routine service tasks.

2. **Initial Inefficiencies**-There is a period of lower efficiency and higher costs at the beginning of the learning curve. Employees are still acquiring the skills and knowledge needed to perform their tasks effectively. During this phase, errors and rework may be more common phenomenon, showing higher initial costs and potentially slower production or service times. These initial inefficiencies can be a significant drawback for organizations need quick results or have limited budgets.

3. **Inflexibility**-- There can be a tendency towards rigidity, as employees or processes become more efficient at specific tasks . Workers may become very specialized in their current methods ,that they resist changes or innovations . This inflexibility can be a disadvantage in rapidly changing industries where adaptability is key factor for progress. A strong focus on current processes and efficiencies might discourage exploration of potentially more effective methods or technologies, leading to a stagnation in innovation .

VARIOUS WAYS FOR ORGANIZATIONS TO USE THE LEARNING CURVE FOR DESIGNING EFFECTIVE EMPLOYEE TRAINING PROGRAMME

1. **Define unit of output**- Set long and short-term outcomes to evaluate employee performance and training effectiveness with purpose of training program and focus what employees are expected to accomplish by the end of training .
2. **Personalized Training**- Personalized training encourage employee engagement, improves training effectiveness, and helps flatten the learning curve. Formulate personalized learning programs with training for individual ,job roles and learning types.
3. **Invest in Training Technology**- Various types of employee training software can be set up for creating and managing employee training programs. More organizations interested in employee training programme to implement effective training with personalized learning content that uses user analytic to help shorten the learning curve across employees. Corporate LMS(Learning Management System) – L&D (Learning and Development) , Digital Adoption Platform (DAP)– Video Training Software (VTS) .
4. **Make Informed Decisions**-When the current training process is not working, explore alternative employee training method and implement other modifications to fine-tune your training programs as data from the learning curve shows . It take a few rounds of trial and error to find the right change that improves performance.
5. **Establish Time Frame**- It is for gaining set of desired outcomes to understand whether or not training methods are providing the expected results to shorten the learning curve. As new hires should be able to create and manage leads and accounts on a company's CRM (Customer Relationship Management) platform after completing a 3-week CRM training program.
6. **Efficient on Boarding**- Be sure to create an efficient on boarding process to help a new hire acquire competence and remain confident in their role. A strong on boarding process provides newly hired team members with the right information, training, and tools during their first few weeks at a company, making their learning curve more productive and much shorter in the future.
7. **Mentor Coaching**- A formal employee training program is make effective , it does not provide all knowledge and information employees need to perform their roles effectively. A real-life coaching from an experienced professional – a supervisor, mentor, or veteran employee – can be effective to acquire knowledge in real-time.

8. **Continuous Monitoring**- Continuous monitoring minimize the problems as they appear, easily correct and modify as required.

APPLICATIONS OF THE LEARNING CURVE THEORY IN BUSINESS

1. Project Management--The project teams involved in learning process becomes more proficient with repeated tasks done or similar projects repeated . Initially , a project may take longer time and involve more resources due to unfamiliarity or unanticipated challenges . As the team experience increases , they develop more efficient processes, better problem-solving skills, and a deeper understanding of the project requirements, in turn decrease time and cost in subsequent projects.

2. T**echnology Adoption**- The use of new technology in an organization effect initially as employees can take more time to operate new systems or software, decreases productivity and potential resistance to change. When time goes , they become more familiar with the technology, improve proficiency , increase productivity, innovation, and often a competitive advantage.

3**. Employee Training**-At the beginning, new employees are trained , then a steep learning curve shows ,it needs more time to complete tasks and expect more guidance . When as the experience and knowledge increases, their productivity increases. The impact of quality of training programs, the complexity of the job, and the individual learning capabilities are on learning curve .

4. **Healthcare and Medicine**--In healthcare , the learning curve with various aspects as surgical procedures, diagnosis methods, and patient care techniques. In the beginning, surgeons may take more time to perform a particular procedure, but as they repeat it, their speed and efficiency improve, in fact leading to better patient outcomes. Healthcare professionals are using new medical technologies or treatment methods become comfortable as experience increases.

In nut shell , it is explained that application of learning curve in business , consider as a new approach placed on a manufacturing line. As the employee becomes more proficient at their job, they will be able to manufacture more goods in a short period of time (all else being equal)and contribute in decreasing cost .

BENEFITS OF LEARNING CURVE IN BUSINESS

(a) Companies aware about an employee earns per hour and can derive the cost of producing a single unit of output based on the number of hours needed.

(b) A well-placed employee who is set up for success should decrease the company's costs per unit of output over time.

(c) Businesses can use the learning curve to expose production planning , cost forecasting, and **logistic schedules.**

CONCLUSION

Learning curve helps to study the rate of improvement as experience increases in production process in business . It is a visual representation of time takes to acquire new skills or knowledge. The benefit of a learning curve is used as a planning tool to follow operational efficiencies increases productivity . The learning curve theory shows , as individuals or organizations perform a task with more efficiency over time and applicable in project management, employee training, technology adoption, healthcare, and medicine . The learning curve explains process where a task can be performed in time as the performer of that task gains efficiency as allocation of workers time, dedicating training for new procedures/technique, or allocating costs for new products . A high or steep learning curve explains time and available resources to perform an initial task and also performance of the same task take less time due to the task in process become easier to learn . A high learning curve in a business indicate it can need training, workers involve become more efficient over time .It estimate the real cost of a project and production costs and cost per unit.In the long run, a company can use information to plan financial forecasts, price of goods, and anticipate whether it will meet customer demand. The application of learning curve in business is as efficiency effect cost and experience effect productivity and quality of product.

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