Analytics in Learning

Better learning efficiency and targeting through data analytics

Analytics in learning is not a new concept. It has been around in pedagogy since mass education allowed teachers to gather student performance data and use it to refine their teaching techniques. From comparing student performance and administering appropriate attention, to setting test and exam benchmarks, analytics has been fundamental in learning mechanisms. With the advent of modern technology, more and more learning is being disseminated through computers and mobile devices. A large amount of learning even happens off the regular channels, through Social media, Wiki's and even peer to peer communication (chat, e-mail etc.). The data generated is at an unprecedented level, yet the effective use of this data remains nascent.

Learning Analytics gives a focus on the use of this data to benefit the outcome of a learning activity. Tanya Elias (2011) put it as *"...the focus appears to be on the selection, capture and processing of data that will be helpful for students and instructors at the course or individual level. Moreover, learning analytics is focused on building systems able to adjust content, levels of support and other personalized services by capturing, reporting, processing and acting on data on an ongoing basis in a way that minimizes the time delay between the capture and use of data."*

Using tools like predictive analytics, machine learning and multi-source knowledge mapping we can create a system which would cater to the requirements of effective Learning Analytics.

DESIGNING BETTER LEARNING

The way to find the optimal learning path is through classification and correlation. In a learning system there exists actors (student, teacher, content/courses, external information), actions (study, discuss, share, test, apply etc.) and outcomes (score, retention, skill etc.). The goal is to break down the attributes of each, classify these attributes and map them in a way that answers questions like:

- What courses should I take to achieve this goal?
- What components should be in a program for a specific target group?
- Which learners need mentor intervention? Which are under tasked? Which require refreshers?
- What content characteristics (video, text, interactivity etc.) drive retention, score, external attribute development?

A learning analytics system can provide the ability to classify learning elements using attribute values and using basic statistical tools determine the mapping between these classifications and desired outcomes. As given in the example below, this would lead to valuable insights for Instruction and content design.

$$y = 0.2759x + 37.018$$
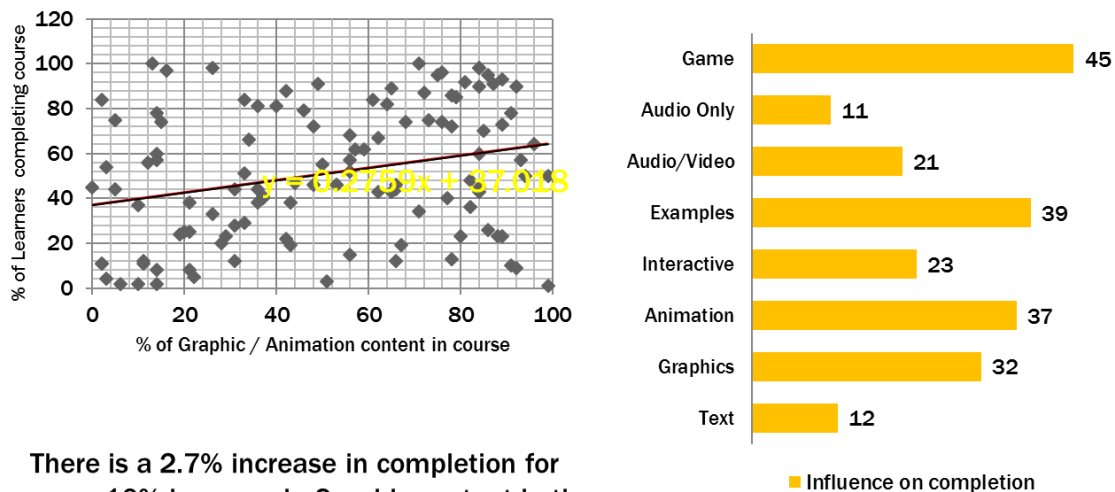
There is a 2.7% increase in completion for every 10% increase in Graphic content in the course

Gaming content is more than 2 times influential towards completion of a course than AV content.

AUTOMATING CONTENT DELIVERY THROUGH ANALYTICS

Dawson et al. (2010) noted:
"The information on student behavior captured by the LMS has been so rarely interrogated and adopted beyond basic load and tool usage. The quantity and diversity of data available regarding student online learning behavior, interactions with peers and teaching staff and access to other institutional ICT systems (student services, library, etc.) for example, affords an opportunity for integrating automated student learning support and services."

The case for automating learning delivery is taken up by adaptive systems. Adaptive systems can change its response to inputs based on context (historical data) and circumstance (data gathered from other sources). The efficiency of an adaptive system is measured by its ability to optimize on results by effecting these changes. Adaptive systems are built to be able to gather data, analyze, and formulate recommendations and decisions in order to optimize certain criteria, in this case learning.

Intelligent and personalized recommendation through Machine Learning – The system will use neural network algorithms to create personalized learning paths for students according to their goals:

- Recommendations on courses to study, time to spend and refreshers based on a student's progress.
- Creating dynamic course structures which take into account historical data not only from the student but also peers.
- Recommending Interventions to teachers/mentors based on learning progress of an individual or group.
- Certifications and awards: Awards given automatically when a learner jumps to another level among peers (slow learner to fast tracker)
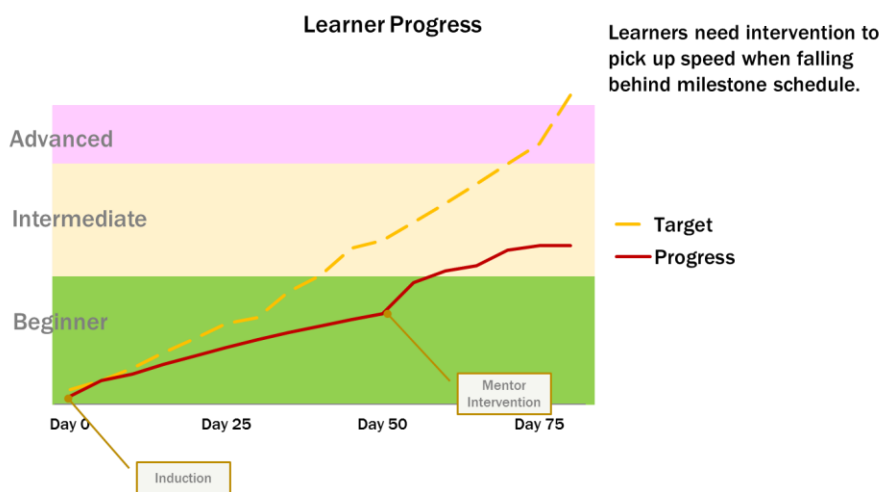
Machine Learning Algorithms (sample)

	Unsupervised	Supervised
Continuous	• Clustering & Dimensionality Reduction 　○ SVD 　○ PCA 　○ K-means	• Regression 　○ Linear 　○ Polynomial • Decision Trees • Random Forests
Categorical	• Association Analysis 　○ Apriori 　○ FP-Growth • Hidden Markov Model	• Classification 　○ KNN 　○ Trees 　○ Logistic Regression 　○ Naive-Bayes 　○ SVM

Rule Based Expert System – A system which would monitor parameters and generate notifications based on pre-defined rules.

LMS Data → Set of Rules → Inference → Actions / Recommendations
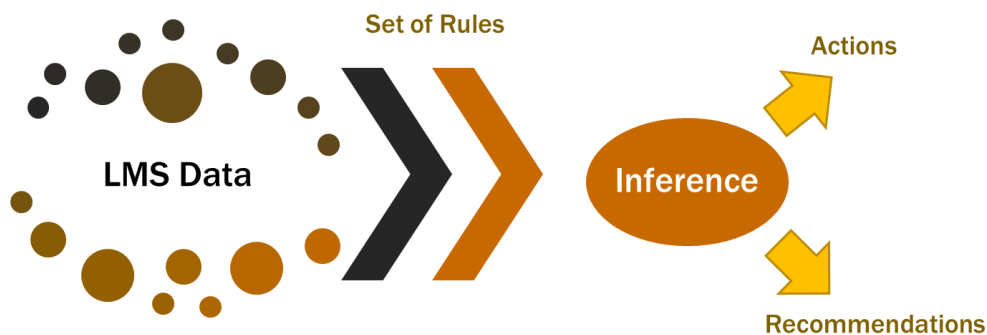
For Example:

- Personalized tracking of skill based progress of a student where a one-to-one session with an SME is automatically assigned when rate of progress falls below a threshold
- Refresher materials start being assigned after completion of a set of courses. Further refreshers being sent to only students who have not scored well in previous assessments.
- Content being put up for review (ID, Copy) when the average rating falls below a certain benchmark.
- Adaptive assessments: Easier or more difficult questions as per learner progress and Scoring based on learner ability and progress

Learner Progress

Learners need intervention to pick up speed when falling behind milestone schedule.

Advanced

Intermediate

- Target
- Progress

Beginner

Day 0   Day 25   Day 50   Day 75

Mentor Intervention

Induction

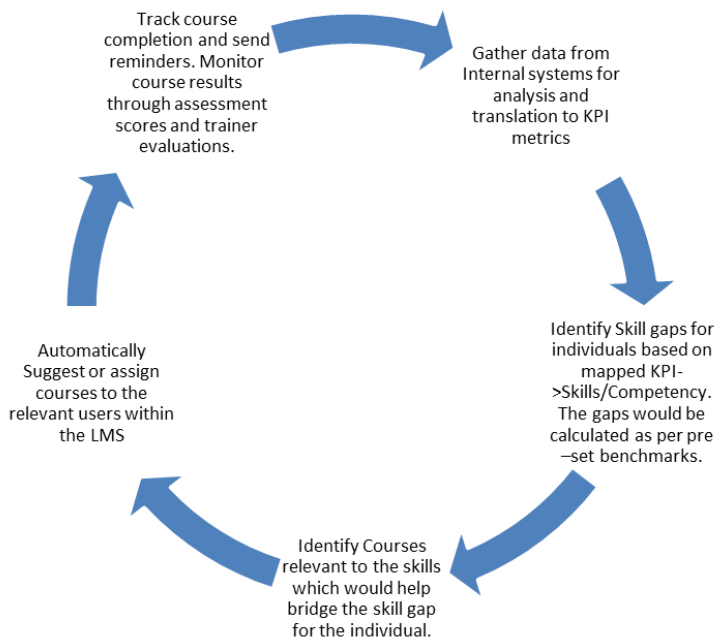# CONTINUOUS SKILL DEVELOPMENT FOR CORPORATE IMPLEMENTATIONS

For Corporates, learning and training is primarily a tool to increase employee performance. This simple fact is often lost to many learning systems. Corporates view training as an investment and as any investment are keen on maximizing the ROI. Employee performance has direct impact on ROI. The most effective way to incorporate a mechanism which can implement monitor and drive ROI is through a Skill and competency management system which links to KPI's and provides a continuous skill development cycle. Measurement of the impact of training to the Key Performance Indicators (KPIs) of an employee is key to the success of any learning initiative in a corporate organization.

Based on the ADDIE Model this system integrates with a performance management or CRM system to provide the ability to provide an automatic and continuous improvement cycle which would be targeted to the users at the exact time that they need the learning.

The ADDIE model is a framework that lists generic processes that instructional designers and training developers use. It represents a descriptive guideline for building effective training and performance support tools in five phases. Analysis, Design, Development, Implementation and Evaluation.
ADDIE is an Instructional Systems Design (ISD) framework. Most current ISD models are variations of the ADDIE process. Other models include the Dick & Carey and Kemp ISD models.

revision → Analyze → revision

Implement ← Evaluation ← Design
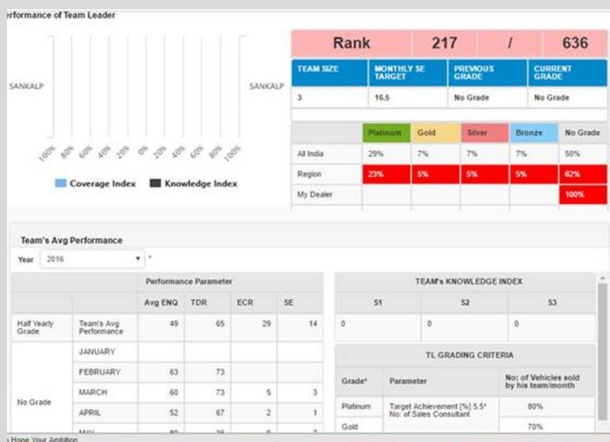
revision → Development ← revision
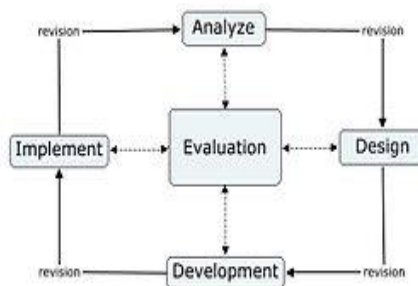
- Create a Skill/Competency matrix for each job role in the organization.
- Analyze the internal systems to gather data for calculating KPI's for the users.
- Create Benchmarks on the KPI's to indicate trigger levels.
- Link Trigger levels to the skill/competency matrix, so that whenever the KPI dips below the trigger level a skill gap is identified.
- Link Targeted content to each skill level which can be suggested to the user's basis their KPI scores.

Track course completion and send reminders. Monitor course results through assessment scores and trainer evaluations.

Gather data from Internal systems for analysis and translation to KPI metrics

Identify Skill gaps for individuals based on mapped KPI->Skills/Competency. The gaps would be calculated as per pre –set benchmarks.

Identify Courses relevant to the skills which would help bridge the skill gap for the individual.

Automatically Suggest or assign courses to the relevant users within the LMS

KPI linked learning: Case Study

For Toyota Kirloskar Motors (TKM) India G-Cube had developed a continuous improvement system by integrating the LMS with their Sales Numbers. The Sales executives at all their dealer outlets would have a dashboard on the LMS showing them their sales numbers along with the benchmarks.This was combined with their learning scores to provide a grade to the user. User's had to maintain a certain grade to be eligible for appraisals and promotions.
The system helps by looking at the KPI's which are below the benchmark (in Red) and linking them to the courses in the LMS. The LMS identifies the Skill gap automatically from the KPI's and posts suggested courses to the user.

This has helped TKM deliver Just in time learning to the sales personnel without any intervention from the L&D department.On time delivery and tracking of these skill based courses have not only help improve performance but also provide invaluable input in terms of the effectiveness of the content itself.

ANALYSING SOCIAL LEARNING

Online knowledge repositories like wikis, discussion forums, videos, blogs etc. shared by contributors is increasingly becoming the de-facto learning resource for students and corporate employees. In "Leading the Learning Revolution", Jeff Cobb posits: *…as much as 80 percent of our learning happens in an informal manner, and a great deal of it is based on our interactions with other people. Why does it matter? It is very often in the context of this other 80 percent that we make decisions about more formal learning opportunities.*

Mapping a learners interactions with social knowledge repositories, through its phases of **Search -> Study -> Rating -> Recommendation -> Contribution**, can enable learning system enhance a users Social learning experience. **Search** can be made more targeted to the users curriculum and current acumen. **Study** can be tracked and then tested automatically to evaluate retention and understanding. **Rating & Recommendations** can be aggregated to help other users find the right content. Finally contribution can be tracked and rewarded as a fulfillment of the Social learning cycle. Modern Learning systems have to come equipped with social interaction tracking and analysis tools to bring this powerful learning format into the fold.

SUMMARY

Analytics has been around in pedagogy since mass education allowed teachers to gather student performance data and use it to refine their teaching techniques. Learning analytics focusses on building systems that help adjust content, levels of support and other personalized services by capturing, reporting, processing and acting on data. It has to be an ongoing process to minimize the time delay between the capture and use of data.

With the advent of modern technology, more and more learning is being disseminated through computers and mobile devices. The data generated is at an unprecedented level, yet the effective use of this data remains nascent. Using tools like predictive analytics, machine learning and knowledge mapping we can create a system which would cater to the requirements of effective Learning Analytics.

ABOUT G-CUBE

G-Cube is an award-winning eLearning services company that designs, develops and delivers technology-based learning solutions. Its solutions help organizations to improve their performance by using learning as a tool. Its Learning solutions are broadly categorized into e-Learning Design, Courses Development and Learning Delivery Solutions. G-Cube's e-learning services include custom content development, mobile learning.

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