



E-ISSN: 2706-8927  
P-ISSN: 2706-8919  
[www.allstudyjournal.com](http://www.allstudyjournal.com)  
IJAAS 2020; 2(1): 197-210  
Received: 14-11-2019  
Accepted: 18-12-2019

**Mohammad Ismail Khattab**  
Department of Software  
Engineering Faculty of  
Computer Science, Nangarhar  
University- Afghanistan

**Mohammad Yusuf Mohmand**  
Department of Database and  
Information Systems, Faculty  
of Computer Science,  
Nangarhar University –  
Afghanistan

**Corresponding Author:**  
**Mohammad Ismail Khattab**  
Department of Software  
Engineering Faculty of  
Computer Science, Nangarhar  
University- Afghanistan

## Role of information technology in increasing educational data accuracy

**Mohammad Ismail Khattab and Mohammad Yusuf Mohmand**

### Abstract

Information technologies have influenced each part of human action and have a potential task to carry out in the field of instruction and preparing, exceptionally, in separation training to change it into an imaginative type of understanding. The need of new innovations in instructing learning process becomes more grounded and quicker. The data age turns into a period of information giving sound and unequaled attainability to disclosure, trade of data, correspondence and investigation to reinforce the instructing learning process. Information advances help in advancing chances of information sharing all through the world. These can support the instructors and understudies having exceptional data and information. Precise and right data is fundamental for powerful instructing and learning; and data advancements are "set of devices that can help give the opportune individuals the correct data at the ideal time." Students are autonomous and they can settle on most ideal choices about their examinations, learning time, spot and resources. Students can work in synergistic and intuitive learning conditions successfully conveying, sharing data and trading thoughts and learning encounters with all in the earth.

**Keywords:** Technology, increasing educational data accuracy

### Introduction

"Work with data innovation – carries understudies important availability with educators, different schools and understudies, and a wide system of experts around the world. Those associations flavor the school day with a feeling of genuine importance, and widen the instructive network." An abundance of information at the snap of the keys, a tremendous greatness of alternatives to introduce one's considerations, a perpetual stockpiling framework with a zillion gigabytes of information Welcome everyone to the hello tech age where we are demi-divine beings by the minor punching of catches. Progressions in data and correspondence innovation assume a noteworthy job in planning understudies to apply what they realize in any subject and discover their place in a worldwide workforce. With PCs, tablet PCs and other cell phones assuming an undeniably significant job in training today, a comprehension of data innovation has gotten exceptionally imperative.

Data Technology utilized in the study halls improves exercises and guidelines. Having cutting-edge data and research accessible with just a mouse click just as the web, guarantees that the understudies have exact and practical data. It is no big surprise that understudies are urged to attempt a fortune chase of information and assemble data on determined themes. Their inventiveness is activated with different perspectives and pictures amassed from over the globe. Be it anticipates assignments, introductions or trade of data starting with one goal then onto the next, understudies realize how to cook the perch and splendidly present their perspective.

Numerous instructors are taking a gander at methods for applying the innovation to each subject and change the manner in which educators and understudies approach them. By carefully sorting out what was once on paper, we have simpler access to significant data just as an important device in dynamic. Numerous libraries utilize an advanced database to make data promptly accessible and make the instruction procedure smoother. This has likewise cleared path for the instructors to communicate with partners through video conferencing, access and accumulate information in the support of records just as utilization of more multi-media rich applications and projects to design progressively viable and intelligent exercises. Improved correspondence is encouraged inside the educational system, network and the groups of the understudies. Schools that use web based frameworks for understudy grades,

participation subtleties, discipline records and schoolwork data right away pass on the equivalent to the guardians. Unique occasions, instructional schedules, connections to instructive destinations are for the most part accessible on the school sites. Schools can communicate exercises to numerous homerooms at the same time as methods for offering courses in low-enrolment branches of knowledge. This likewise permits understudies in remote areas to have direct connection with instructors at a focal area. Separation training has gotten progressively worldwide, inside the compass of individuals over the world.

Society is the beneficiary of the last item, the understudy, of the instructive framework. The understudy must be set up to confront the difficulties of a general public and occupation advertises concentrated on innovation. IT is an adaptable instrument which when appropriately utilized, extraordinarily helps learning in all territories. Moreover, authority of the utilization of those apparatuses will furnish understudies with significant abilities to use in the different jobs they in this way take up.

### Related works

Romero and Ventura <sup>[9]</sup>, have an examination on illuminating information mining some spot in the extent of 1995 and 2005. They thought about that edifying information mining is a promising district of research and it has a particular prerequisites not introduced in different areas. At this moment, ought to be a coordinated towards instructive area of information mining.

El-Halees <sup>[5]</sup>, gave an important assessment that utilized instructive information mining to isolate understudies' learning conduct. The objective of his appraisal is to show how strong information mining can be utilized in front line preparing to improve understudy' execution. He utilized understudies' information from database course and amassed each open datum including particular records and scholastic records of understudies, course records and information began from e-learning structure. By at that point, he applied information mining procedures to find different sorts of information, for example, association rules and depiction rules utilizing choice tree. Besides he pressed the understudy into groups utilizing E Mclustering, and perceived every single uncommon case in the information utilizing inconsistency appraisal. At long last, he introduced by what strategy can we profited by the found information to improve the showcase of understudy.

Al-Radaideh *et al.* <sup>[1]</sup>, applied the information mining strategies, especially assembling to help in improving the possibility of the higher edifying framework by reviewing understudy information to consider the primary attributes that may affect the understudy execution in courses. The emptied assembling rules depend upon the choice tree as an arrangement system, the evacuated demand rules are assessed and studied. It awards understudies to foresee the last grade in a course under investigation. These contrasted data will be given with the class instructor before the conduction of last, most critical test. This appraisal asks the teachers to diminish the shelling degree by making fitting strides at immaculate time and improve the presentation of understudies.

Baradwaj and Pal <sup>[3]</sup>, applied the depiction as information mining structure to assess understudy' execution, they utilized choice tree framework for demand. The objective of their assessment is to expel information that portrays

understudies' showcase in end semester assessment. They utilized understudies' information from the understudy' past database including Attendance, Class test, Seminar and Assignment marks. This appraisal helps prior in perceiving the dropouts and understudies who need astounding idea and award the teacher to give fitting reprimanding.

Shannaq *et al.* <sup>[11]</sup>, applied the depiction as information mining structure to foresee the measures of enlisted understudies by assessing adroit information from picked understudies to consider the standard properties that may affect the understudies' steady quality (number of picked understudies). The detached solicitation rules depend upon the choice tree as an arrangement framework, the removed assembling rules are considered and assessed utilizing indisputable examination strategies. It permits the University the authorities to plan critical assets for the new selected understudies and shows at a beginning period which sort of understudies will conceivably be picked and what regions to move upon in front line preparing structures for help.

Chandra and Nandhini <sup>[4]</sup>, applied the association rule mining assessment subject to understudies' shelled courses to perceives understudies' misstep structures. The objective of their appraisal is to perceive secured relationship between the assaulted courses and proposes pertinent clarifications behind the inability to improve beyond what many would consider possible understudies' presentations. The separated affiliation rules uncover some concealed occurrences of understudies' attacked courses which could fill in as an establishment stone for scholarly organizers in picking canny choices and a guide in the enlightening system re-orchestrating and alteration with a definitive goal of improving understudies' presentation and diminishing thwarted expectation rate.

Improving getting ready is a tremendous issue for our general populace. Assessments, our undeniable presentation against various countries, and various parts have pushed getting ready to the front line of national conclusive issues, extremely behind remedial organizations change. Progression can be used to improve educating and learning and help our understudies be incredible.

While everybody couldn't imagine anything better than to see progressively humble schools and class sizes, headway can't do that truly. In any case, improvement can be a "power multiplier" for the instructor. Using learning the authorities structures (LMS) understudies can locate a decent pace to discover support on request past the physical reach of their educator. Progression can correspondingly extend planning in another manner.

Planning doesn't stop toward the completing of the school day. Understudies can locate a decent pace, and assignments by techniques for the web at whatever point and any place they have a web alliance. For understudies who need to contribute greater imperativeness rehearsing an idea, online activities and informational course of action can in like way help them with working at their own pace and still stay aware of their allies.

Parental obligation is another factor affecting understudy achievement that can connect with advancement. Most gatekeepers these days have very clamoring plans. Thusly, they most likely won't get the opportunity to help their childhood with schoolwork at home or come to class for social affairs. Headway can help. Guardians may have the decision to meet with educators through web conferencing

or other online created effort contraptions. Moreover, they can check their juvenile's advantage, assignments, and grades through online structures. They can in like manner talk with their youths from work by strategies for email, educating, informing, and video calling.

Progression based assignments can in like way move understudies to think and work together rather than holding, regardless of whether they're utilizing the web for investigate or to relate with different understudies or bosses who are not so much present. These undertakings in like manner help them with learning advancement aptitudes they'll have to win in the pushed workforce.

Regardless of the way that advancement itself can be over the top, it can in like way help schools with setting aside cash. Virtual field trips, electronic accounts, email instead of printed invigorates, virtual labs, electronic course readings, and the incalculable free online assets help schools with sparing money and still give understudies stunning instructive encounters.

Instructors can besides use advancement to find assets and go to virtual pro improvement courses and social events (most are free). They can in like manner make solitary learning systems with Ning, Twitter, and various assets for find and offer contemplations and assets, and get support from their accessories.

### **Educational Data Mining**

Instructive information mining is rising as an exploration territory with a suite of computational and mental strategies and research approaches for seeing how understudies learn. New PC upheld intuitive learning strategies and apparatuses—savvy coaching frameworks, recreations, games—have opened up chances to gather and investigate understudy information, to find examples and patterns in those information, and to make new revelations and test theories about how understudies learn. Information gathered from internet learning frameworks can be totaled over huge quantities of understudies and can contain numerous factors that information digging calculations can investigate for model structure.

Similarly likewise with early endeavors to comprehend online practices, early endeavors at instructive information mining included mining site log information (Baker and Yacef 2009), however now progressively incorporated, instrumented, and refined web based learning frameworks give more sorts of information. Instructive information mining by and large stresses diminishing learning into little parts that can be investigated and afterward affected by programming that adjusts to the understudy (Siemens and Baker 2012). Understudy learning information gathered by web based learning frameworks are being investigated to create prescient models by applying instructive information mining strategies that group information or discover connections. These models assume a key job in building versatile learning frameworks where adjustments or mediations dependent on the model's forecasts can be utilized to change what understudies understanding straightaway or even to prescribe outside scholarly administrations to help their learning.

A significant and exceptional element of instructive information is that they are progressive. Information at the keystroke level, the appropriate response level, the meeting level, the understudy level, the study hall level, the educator level, and the school level are settled inside each other

(Baker 2011; Romero and Ventura 2010). Other significant highlights are time, grouping, and setting. Time is essential to catch information, for example, length of training meetings or time to learn. Grouping speaks to how ideas expand on each other and how practice and coaching ought to be requested. Setting is significant for clarifying outcomes and knowing where a model might work. Techniques for various leveled information mining and longitudinal information displaying have been significant advancements in mining instructive information.

Instructive information mining scientists (e.g., Baker 2011; Baker and Yacef 2009) see the accompanying as the objectives for their examination:

Anticipating understudies' future learning conduct by making understudy models that join such nitty gritty data as understudies' information, inspiration, met insight, and mentalities; Discovering or improving area models that describe the substance to be scholarly and ideal instructional arrangements; Studying the impacts of various types of educational help that can be given by learning programming; and Advancing logical information about learning and students through structure computational models that consolidate models of the understudy, the space, and the product's teaching method.

To achieve these four objectives, instructive information mining research utilizes the five classes of specialized techniques (Baker 2011) depicted beneath.

Expectation involves building up a model that can surmise a solitary part of the information (anticipated variable) from a mix of different parts of the information (indicator variables). Examples of utilizing forecast incorporate distinguishing such understudy practices as when they are gaming the framework, participating in off-task conduct, or neglecting to address an inquiry effectively regardless of having an aptitude. Prescient models have been utilized for understanding what practices in an internet learning condition—cooperation in conversation gatherings, taking practice tests and such—will anticipate which understudies may bomb a class.

Expectation shows guarantee in creating space models, for example, interfacing techniques or realities with the particular grouping and measure of training things that best show them, and estimating and understanding understudy instructive results, for example, accomplishment on posttests subsequent to mentoring (Baker, Gowda, and Corbett 2011).

### **1. Clustering**

Alludes to discovering information focuses that normally bunch together and can be utilized to part a full dataset into classifications. Instances of bunching applications are gathering understudies dependent on their learning challenges and collaboration designs, for example, how and the amount they use devices in a learning the board framework (Amershi and Conati 2009), and gathering clients for reasons for prescribing activities and assets to comparable clients. Information as differed as web based learning assets, understudy subjective meetings, and postings in conversation gatherings can be dissected utilizing procedures for working with unstructured information to remove attributes of the information and afterward bunching the outcomes. Bunching can be utilized in any space that includes arranging, even to decide how a

lot of coordinated effort clients show dependent on postings in conversation discussions (Anaya and Boticario 2009).

## 2. Relationship

Mining includes finding connections between factors in a dataset and encoding them as rules for sometime in the future. For instance, relationship mining can distinguish the connections among items bought in web based shopping (Romero and Ventura 2010).

- Association rule digging can be utilized for discovering understudy botches that co-happen, partner content with client types to construct proposals for content that is probably going to be fascinating, or for making changes to showing draws near (e.g., Merceron and Yacef 2010). These procedures can be utilized to relate understudy action, in a learning the board framework or conversation discussions, with understudy grades or to research such inquiries as why understudies' utilization of training tests diminishes over a semester of study.
- Sequential design mining manufactures decides that catch the associations between events of successive occasions, for instance, discovering transient arrangements, for example, understudy botches followed by help chasing. This could be utilized to identify occasions, for example, understudies relapsing to making blunders in mechanics when they are composing with increasingly mind boggling and basic reasoning strategies, and to break down collaborations in online conversation discussions.

Key instructive uses of relationship mining incorporate disclosure of relationship between understudy execution and course arrangements and finding which educational techniques lead to increasingly successful or strong learning. This last territory—called instructing examination—is of developing significance and is planned to assist analysts with building computerized frameworks that model how compelling educators work by mining their utilization of instructive frameworks.

## 3. Distillation

For human judgment is a procedure that includes portraying information in a manner that empowers a human to rapidly recognize or group highlights of the information. This zone of instructive information mining improves AI models since people can recognize designs in, or highlights of, understudy learning activities, understudy practices, or information including joint effort among understudies. This methodology covers with visual information investigation (portrayed in the third piece of this area).

## 4. Discovery

With models is a procedure that includes utilizing an approved model of a marvel (created through expectation, bunching, or manual information building) as a segment in further examination. For instance, Jeong and Biswas (2008) manufactured models that sorted understudy action from essential conduct information: understudies' associations with a game-like learning condition that utilizations learning by instructing. An example understudy action observed from the information was "map testing." A model of guide examining then was utilized inside a second model of learning techniques and helped analysts concentrate how the methodology changed across various exploratory states.

Revelation with models bolsters disclosure of connections between understudy practices and understudy attributes or logical factors, examination of research inquiries over a wide assortment of settings, and coordination of psychometric displaying structures into machine-learned models.

## Learning analytics

Learning investigation is getting characterized as a region of research and application and is identified with scholarly examination, activity examination, and prescient analytics. Learning examination draws on a more extensive cluster of scholastic orders than instructive information mining, fusing ideas and systems from data science and human science, notwithstanding software engineering, insights, brain research, and the learning sciences.

Not at all like instructive information mining, learning investigation for the most part doesn't underline lessening learning into segments yet rather looks to comprehend whole frameworks and to help human dynamic.

Learning examination underscores estimation and information assortment as exercises that organizations need to embrace and comprehend, and centers around the investigation and detailing of the information. Not at all like instructive information mining, learning investigation doesn't for the most part address the improvement of new computational strategies for information examination however rather addresses the use of known techniques and models to respond to significant inquiries that influence understudy learning and hierarchical learning frameworks. The Horizon Report: 2011 Edition depicts the objective of learning investigation as empowering educators and schools to tailor instructive chances to every understudy's degree of need and capacity (Johnson *et al.* 2011). Dissimilar to instructive information mining, which accentuates framework created and mechanized reactions to understudies, learning examination empowers human fitting of reactions, for example, through adjusting instructional substance, mediating with in danger understudies, and giving criticism.

Specialized strategies utilized in learning examination are shifted and draw from those utilized in instructive information mining. Additionally, learning investigation may utilize:

Informal organization examination (e.g., investigation of understudy to-understudy and understudy to-educator connections and communications to recognize separated understudies, influencers, and so forth.) and Social or "consideration" metadata to figure out what a client is locked in with Similarly as with instructive information mining, giving a visual portrayal of examination is basic to create significant investigations; data is frequently spoken to as "dashboards" that show information in an effectively absorbable structure.

A key use of learning examination is observing and anticipating understudies' learning execution and spotting potential issues early so intercessions can be given to recognize understudies in danger of bombing a course or program of study (Educause 2010; Johnson *et al.* 2011). A few learning investigation models have been created to recognize understudy hazard level continuously to improve the understudies' probability of accomplishment. Instances of such frameworks incorporate Purdue University's Course Signals framework (Arnold 2010) and the Moodog

framework being utilized at the course level at the University of California, Santa Barbara, and at the institutional level at the University of Alabama (EDUCAUSE 2010). Advanced education organizations have demonstrated expanded enthusiasm for learning examination as they face calls for more straightforwardness and more prominent investigation of their understudy enrollment and maintenance rehearses.

Information mining of understudy conduct in online courses has uncovered contrasts among fruitful and ineffective understudies (as estimated by conclusive course reviews) as far as such factors as level of investment in conversation sheets, number of messages sent, and number of tests finished (Macfayden and Dawson 2010). Examination dependent on these understudy conduct factors can be utilized in criticism circles to give increasingly liquid and adaptable educational plans and to help quick course modifications (e.g., sequencing of models, activities, and self-evaluations) in view of investigations of constant learning information (Graf and Kinshuk in press).

### Visual Data Analytics

Visual data analysis blends highly advanced computational methods with sophisticated graphics engines to tap the ability of humans to see patterns and structure in complex visual presentations (Johnson *et al.* 2010). Visual data analysis is designed to help expose patterns, trends, and exceptions in very large heterogeneous and dynamic datasets collected from complex systems. A variety of techniques and tools are emerging to enable analysts to easily interpret all sorts of data. For instance, visual interactive principal components analysis (finding the components of a dataset that reduce many variables into few) is a technique once available only to statisticians that is now commonly used to detect trends and data correlations in multidimensional data sets. Gapminder (<http://www.gapminder.org/>), for example, uses this approach in its analysis of multivariate datasets over time. Websites, such as Many Eyes (<http://www-958.ibm.com/software/data/cognos/manyeyes/>), offer tools for any user to create visualizations (map-based, text-based clouds and networks, and charts and graphs) of personal datasets. Early in its release, the creators of Many Eyes discovered that it was being used for visual analytics, to check for data quality, to characterize social trends, and to reveal personal and collective sentiments or advocate for a position (Viégas *et al.* 2008). Like Many Eyes, other online services, such as Wordle and Flowing Data, accept uploaded data and allow the user to configure the output to varying degrees. To facilitate the development of this field, the National Visualization and Analytics Center was established by the U.S. Department of Homeland Security to provide strategic leadership and coordination for visual analytics technology and tools nationwide, and this has broadened into a visual analytics community (<http://vacommunity.org>). The Horizon Report: 2010 Edition (Johnson *et al.* 2010) describes the promise of visual data analysis (in the four- to five-year time frame) for teaching undergraduates to model complex processes in such subjects as quantum physics. Visual data analysis also may help expand our understanding of learning because of its ability to support the search for patterns. It may be applied, for example, to illustrate the relationship among the variables that influence

informal learning and to “see” the social networking processes at work in the formation of learning communities. Currently, the tools, techniques, and high-resolution displays that enable people to interactively manipulate variables or zoom through the analysis results are still found mostly in research settings. Because interpreting data generated for visual data analysis requires analytical knowledge, researchers have thus far been the major population to use this method. Nevertheless, such sites as Gap Minder offer data aimed at educators and provide teacher professional development to help educators interpret the data. Social Explorer, for example, offers tools for exploring map-based census and demographic data visualizations and is used by both researchers and educators. In the future, advances in visual data analytics and human-computer interface design may well make it feasible to create tools, such as Many Eyes, that policymakers, administrators, and teachers can use.

This section has described the promise of educational data mining (seeking patterns in data across many student actions), learning analytics (applying predictive models that provide actionable information), and visual data analytics (interactive displays of analyzed data) and how they might serve the future of personalized learning and the development and continuous improvement of adaptive systems. How might they operate in an adaptive learning system? What inputs and outputs are to be expected? In the next section, these questions are addressed by giving a system-level view of how data mining and analytics could improve teaching and learning by creating feedback loops.

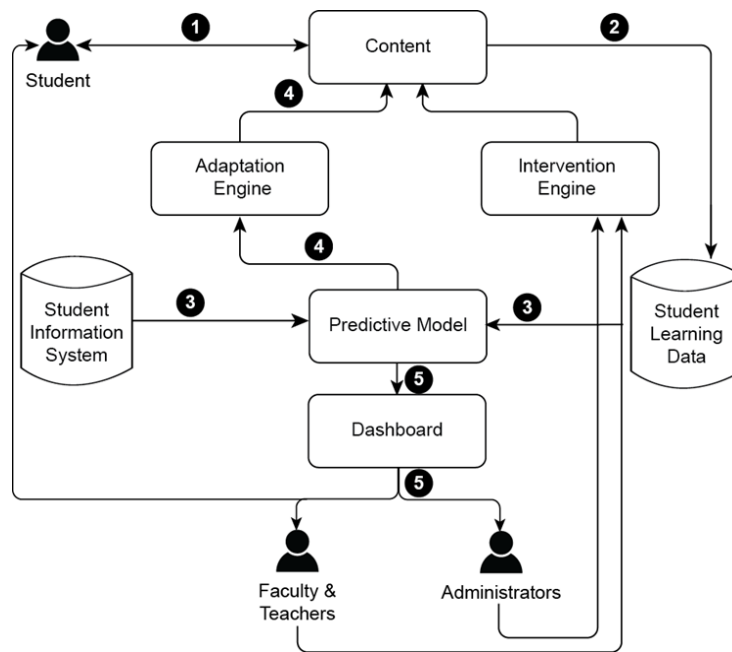
### Data use in adaptive learning systems

Online learning systems—learning management systems, learning platforms, and learning software—have the ability to capture streams of fine-grained learner behaviors, and the tools and techniques described above can operate on the data to provide a variety of stakeholders with feedback to improve teaching, learning, and educational decision making. To demonstrate how such adaptive systems operate, using the predictive models created by educational data mining and the system-level view of learning analytics, this section describes a prototypical learning system with six components (Exhibit 1):

- A content management, maintenance, and delivery component interacts with students to deliver individualized subject content and assessments to support student learning.
- A student learning database (or other big data repository) stores time-stamped student
- input and behaviors captured as students work within the system.
- A predictive model combines demographic data (from an external student information system) and learning/behavior data from the student learning database to track a student’s progress and make predictions about his or her future behaviors or performance, such as future course outcomes and dropouts.
- A reporting server uses the output of the predictive model to produce dashboards that
- provide visible feedback for various users.
- An adaption engine regulates the content delivery component based on the output of the predictive model to deliver material according to a student’s performance

level and interests, thus ensuring continuous learning improvement.

An intervention engine allows teachers, administrators, or system developers to intervene and override the automated system to better serve a student's learning.



**Exhibit 1:** The Components and Data Flow Through a Typical Adaptive Learning System

**Exhibit reads:** The data flow is shown through a box and arrows diagram with a content box on the top with an arrow to a student and two engines underneath shown as boxes: an adaptation engine and an intervention engine, with arrows for each up to the content box. Another arrow connects a predictive model box to the adaptation engine. The predictive model is connected to two databases with incoming arrows. On the right is the student learning database and on the left is the student information system.

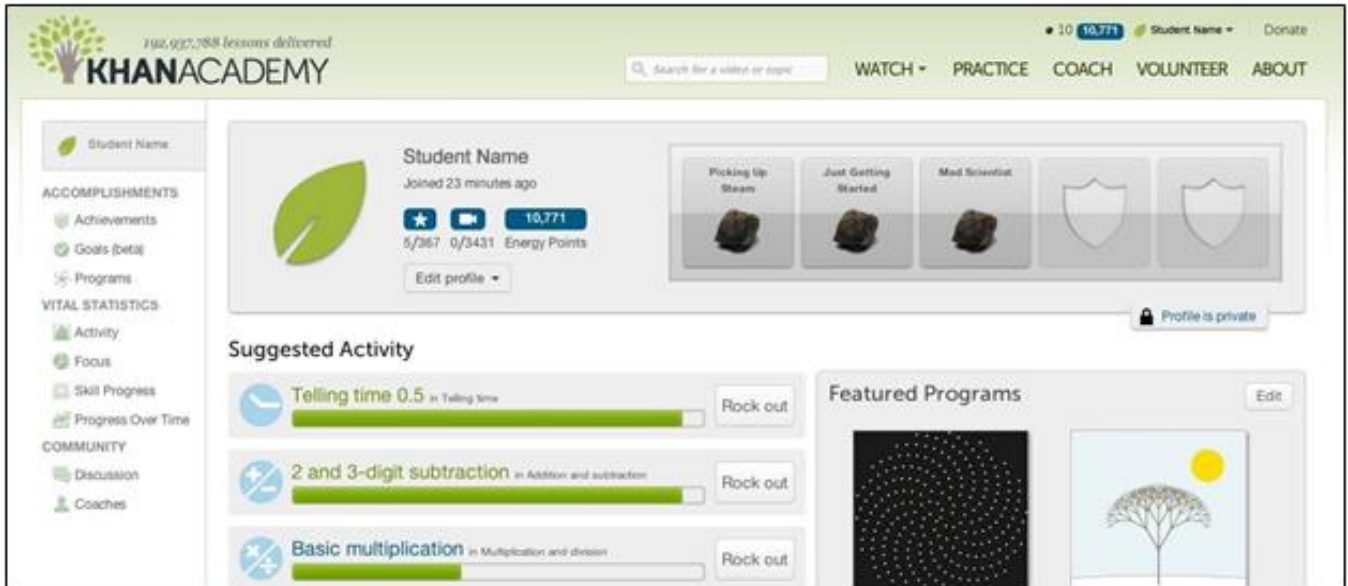
Below the predictive model and connected with an incoming arrow is a dashboard that is shown connected with arrows to faculty and educators and administrators.

Notwithstanding these six inner segments, a versatile learning framework frequently utilizes the understudy data framework (SIS) that is kept up by a school, locale, or foundation as an outside information source. Understudy profiles from the SIS are typically downloaded in cluster mode, as they don't change frequently, and afterward are connected with execution information in the understudy learning database utilizing understudy identifiers in consistence with relevant law. Understudy profiles contain foundation data on understudies that can be utilized to bunch them into explicit classes or to give more factors that may propose a specific understudy is in danger.

The numbers in Exhibit 1 imply the information stream that makes input circles between the clients and the versatile learning framework. The information stream begins with Step 1, understudies creating inputs while cooperating with the substance conveyance segment. (Later on, an understudy may have a compact taking in record that contains data from every past communication with web-based learning

frameworks.) The sources of info are time-stepped and cleaned as essential and put away in the understudy learning database as indicated by predefined structure (Step 2). At specific occasions (not synchronized with understudy learning exercises), the prescient model brings information for examination from both the understudy learning database and the SIS (Step 3). At this stage, various information mining and investigation apparatuses and models may be applied relying upon the reason for the examination. When the examination is finished, the outcomes are utilized by the adjustment motor (Step 4) to change what ought to be accomplished for a specific understudy. The substance conveyance segment presents these balanced PC coaching and showing procedures (Step 4) to the understudy. The discoveries likewise may stream to the dashboard (Step 5), and, in the last advance in the information stream, different clients of the framework analyze the reports for input and react (utilizing the intercession motor) in manners suitable for their job.

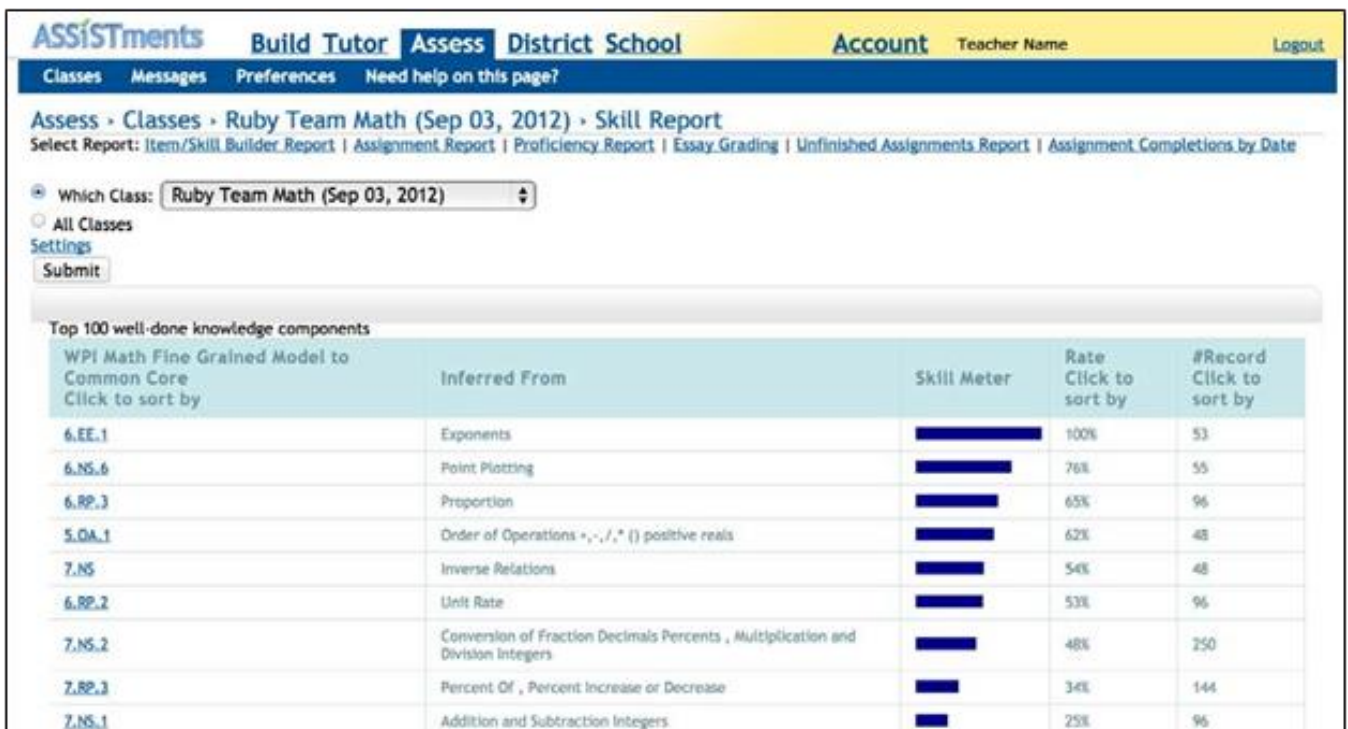
These last advances total input circles as partners get data to advise their future decisions and exercises. Understudies get input on their associations with the substance they are learning through the versatile learning framework. The input ordinarily incorporates the rate right on implanted evaluations and arrangements of ideas they have shown dominance on (Exhibit 2), yet it likewise can incorporate nitty gritty learning movement data (e.g., indications mentioned and issues endeavored). Point by point learning data for one understudy can be contrasted and that for understudies who earned high evaluations so understudies can alter their learning with the framework appropriately.



**Display 2:** Understudy Dashboard Showing Recommended Next Activities

Educators get criticism on the exhibition of every individual understudy and of the class all in all and change their instructional activities to impact understudy learning. By looking at the input information, educators can spot understudies who may require extra assistance or support to invest more energy in the substance and recognize territories where the class all in all is battling. The last zone can be tended to during class time when the teacher can react to questions and address understudy misinterpretations and absence of understanding. For the previous territories, instructors may decide to intercede with the framework to change understudy learning pace or may appoint extra learning

materials focusing on the abilities that are not yet aced (see Case Study 1 on page 22). Learning frameworks regularly track the condition of understudy dominance at the expertise or point level (e.g., the quadratic condition) and can give this data to understudies so they recognize what to examine and to instructors so they know the territories where they should focus further guidance (Exhibit 3). Specialists engaged with the Open Learning Initiative at Carnegie-Mellon University have a comparable vision of understudy and educator criticism frameworks that is controlling their work in creating on the web courses (Bajzek *et al.* 2008) and is depicted in Case Study 2 on page 23.



**Show 3:** Instructor Dashboard with Skill Meter for Math Class

Managers can take a gander at itemized information across various classes to analyze progress for all understudies at a school, to perceive what works and what doesn't in a specific study hall, and to do as such with less exertion. Area managers can utilize information from this sort of dashboard as a reason for deciding if a specific learning intercession is successful at advancing understudy learning, even at the degree of individual ideas (Exhibit 4). Commonly, the point by point learning information the framework gives can be disaggregated by understudy

subgroup (for instance, to perceive how understudies without a course essential perform or to look at guys' and females' advancement in the course), by teacher, or by year. Learning framework information can bolster investigations of how well understudies learn with specific mediations and how execution of the intercession could be improved. Utilizing the information, directors can set arrangements, execute programs, and adjust the approaches and projects to improve instructing, learning, and fulfilment / maintenance / graduation rates.



Display 4: Chairman Dashboard Showing Concept Proficiency for a Grade Level

Scientists can utilize fine-grained student information to try different things with learning speculations and to analyze the adequacy of various sorts of instructional practices and distinctive course structure components. Learning framework engineers can direct quick testing with enormous quantities of clients to improve web-based learning frameworks to all the more likely serve understudies, teachers, and managers.

Scientists utilizing web based learning frameworks can do analyzes in which numerous understudies are doled out indiscriminately to get distinctive educating or learning approaches, and learning framework designers can show elective renditions of the product to numerous clients: form An or adaptation B. This supposed "A/B testing" procedure can respond to investigate inquiries regarding understudy learning, for example, Do understudies learn all the more rapidly on the off chance that they get a great deal of training on a given sort of issue all without a moment's delay ("massed practice") or if practice on that sort of issue is scattered after some time ("dispersed practice")? Shouldn't something be said about understudies' maintenance of this ability? Which sort of training plan is

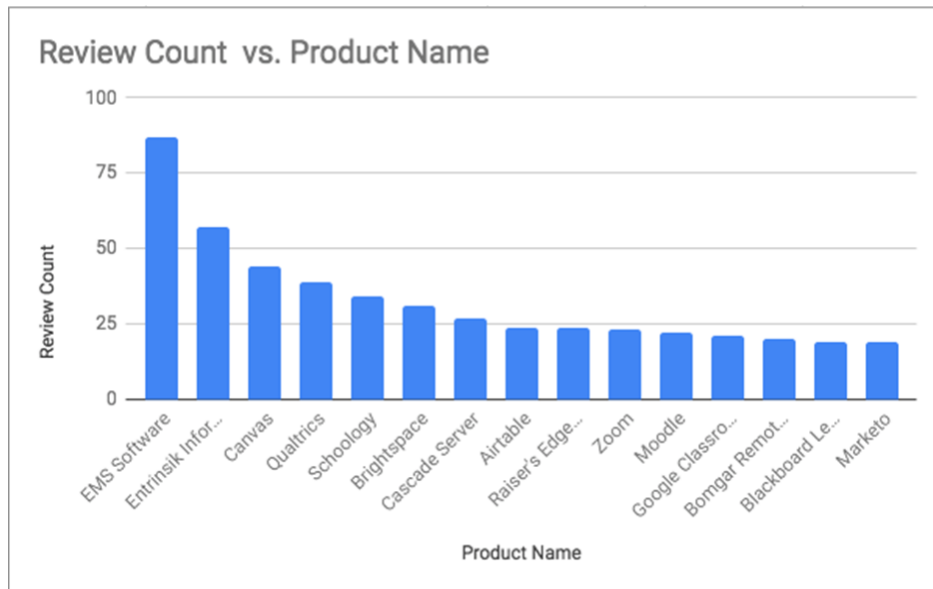
unrivaled for encouraging maintenance? For what sort of understudies, and in what settings?

These contextual analyses exhibit down to earth uses of information rich input circles in versatile learning frameworks. In any case, they don't speak to the full scope of potential utilizations of instructive information mining and learning examination. To show this bigger potential, the following segment traces wide regions where instructive information mining and learning investigation can be applied, many motivated by industry rehearses.

**Trust Radius brought a jump into the information**

We examined our reviews to uncover a couple of examples that were ordering the guidance business. We saw studies formed by people who worked in high guidance, preparing the officials, and fundamental/assistant preparing. The principle 3 things that were most surveyed by people who work in the guidance business likely won't be what people foresee! They are an event the board thing, a business information arrange, and a learning the board structure. Research presumably the most assessed things on Trust Radius by people working in the guidance business.





**Information technologies and teaching learning process Making Students Independent in their Studies**

Utilizing data advancements understudies can choose about their examinations, learning time, spot and assets in a superior way. Understudies can work in increasingly steady conditions, look for help from instructors and colleagues, and offer their learning encounters and thoughts in sentimental and beneficial design.

Dede (1996, p.4) expressed that the improvement of superior figuring and correspondence is making new media, for example, the Www and computer-generated realities. Thusly these new media empower new kind of messages and encounters, for example, relational connections in vivid manufactured situations lead to the arrangement of virtual networks. The imaginative sorts of teaching method engaged by these rising media and encounters advanced the chances of separation instruction and at present virtual training and dispensed with the hindrances of separation and time. New and imaginative learning encounters would be upgraded and energized by these innovations, as by virtual networks, which exist by connections over the globe through worldwide system of PCs nonstop. The worldwide sharing of encounters would make conceivable the gathering introduction type of guidance in separation instruction. Separation training incorporates and depends on the utilization of data innovations to make learning increasingly beneficial and progressively individualized, to give guidance an increasingly logical base and make it fitting and increasingly viable, learning progressively prompt and access to assets increasingly approach. These striking angles can extend the quality and amount of instructional assets. They can serve students at their simplicity as far as time and spot. Rashid (2001, p.270) expressed that:

- Both educators and students can work with others at remote destinations.
- The people group of students can grow to incorporate for all intents and purposes any individual who wishes to acquire data and who isn't avoided by approach or cost.
- They can give genuine access to specialists in colleges, inquire about research centers, the business network, government offices and political workplaces.

Data innovations can advance the chances of rebuilding the teaching48 learning process.

These can change instructing and learning by offering options in contrast to the educator gave data, access to basically boundless assets and open doors for genuine correspondence, coordinated effort and rivalry. The periods of this procedure as portrayed by Marriam *et al.* (1997, p.34) are,

- " creating mindfulness – perceiving that something isn't right or unique;
- exploring elective inquiring about for new thoughts from different foundations and recognizing that change is required;
- making a progress deserting the old methodologies (or significantly changed);
- achieving incorporation putting the pieces from the change stage back together; and
- taking activity placing new thoughts into activity".

The procedure can work at instructional program or institutional level and at least one stages work at the same time. Conventional talks and exhibits can become online interactive media learning encounters for separation students. Web can advance the taking in assets and foundations pull together from educating to learning, from instructor to student. It can make learning condition all through the world by arranged learning networks. Systems may make educative conditions inserted in law based way of thinking of guidance and helping students learn. The attributes of which are:

- "Respect for character;
- Participation in dynamic;
- Freedom of articulation and accessibility of data; and
- Mutuality of obligation in characterizing objectives, arranging and leading exercises and assessing [the process]" (Knowles 1980, p.85).

Learning may happen all the more successfully and powerfully in educative conditions where educator and students are available to one another to interface and trade data and encounters in a benevolent manner. Ennis (1989) deduced in an examination "Receptiveness with respect to teacher expanded their [learner's] want to talk about issues or subjects of premium... these conversations extended their

[learner's] comprehension of the substance and helped them in arranging the data inside a pertinent setting in their own lives". Educative conditions can improve and shape the showing learning procedure to accomplish the ideal objectives. There is a characteristic inclination for understudies to learn and learning can quicken, in intelligent and empowering conditions. Quickening the empowering situations might be mental atmospheres and understudies' communications can make them. Cooperations of understudies can make learning condition increasingly successful and significant and 'a lot of learning happens in an important domain'. Students may get quick criticism and fortification through online learning.

The mental design of such support and anticipation additionally impacts the potential for some random conduct and additionally figuring out how to happen. Wanted adapting consistently expects access to subjective and most recent data assets and web affirms the expanded access to such assets at understudies' pace. Also, Aggarwal (2000, p.11) says "there is no denying that online courses open new instructive access to the non-conventional and geologically scattered understudies. The on-line setting gives a 49 level of adaptability and accommodation not gave by conventional homeroom courses".

Web and WWW give students most recent important data at their own pace and they can frame a virtual network of students at worldwide level. Training associations are receiving data and correspondence innovations uncommonly the PCs, World Wide Web, video chatting and instructive TV in light of their cost viability, access and adaptabilities of decisions.

#### **Understudies use information technologies to**

1. Participate in a media transformation, significantly influencing the manner in which they consider and use data advancements.
2. Improve the methods for learning in new learning designs
3. Extend the capacity and abilities of applying their learning in genuine circumstance.
4. Working in bunches for helpful and cooperative learning
5. Developing self-learning propensities at their own pace and time.
6. Learn with the instructor rather by the educator.
7. Develop request learning propensities.
8. Use right data at opportune time to accomplish right target.
9. Review and investigate subjective information.
10. Exchange learning encounters and data with others understudies and instructors living anyplace on the planet.

Data advances encourage understudies in their learning procedure through their dynamic support on one hand and help instructors then again. Hence,

#### **Instructors use the information technologies to**

1. Present the material in additionally fascinating and appealing manner.
2. Guide and help understudies in looking through the subjective material.
3. Make best utilization of time.
4. Coach the understudies.

5. Provide individualized guidance.
6. Direct the understudies toward agreeable just as community-oriented learning exercises.
7. Prepare learning material for understudies, rather educating in ordinary circumstances.
8. Diagnose the learning issue of understudies and help them to survive.
9. Solve the investigation issues of understudies.

Data innovations influence the showing learning process in various manners. These helps the instructors in planning address notes for intriguing introduction, from one perspective and encourages the understudies then again. Various innovations help the educators and understudies as per their separate nature and capacities of capacity and introduction. For instance PCs are utilized in training for different purposes as they can store and recover an enormous measure of data. Each of the 20 volumes of the Oxford English Dictionary are contained on one conservative circle. The plate gives moment access to 616,500 words and terms, 137,000 articulations, 2.4 million illustrative citations, 577,000 cross references, and 249,000 historical backgrounds. Likewise, American Memory incorporates Library of Congress assortments of essential materials from American history. Accessible on a mix of PC sound and videodisks, American Memory contains 25,500 photos (dated structure 1800 to 1920); 500 prints and kid's shows about Congress: 60 sound accounts (pre-radio) of mid twentieth century pioneers; 1,610 shading photos taken during World War second, 28 movies of President William McKinley and 350 flyers by clear creators from Reconstruction to the 50 First World War (Menges, 1994; pp 184-185). Information innovations give the chances of worldwide cooperations. Understudies can gain from communications with the data, interface, instructors and co-students utilizing worldwide systems. They can communicate at their own and dispose of their normal work. They may audit and investigate the subjective just as quantitative information trough PC systems. They can take a shot at bunch ventures taking an interest in peer learning and information building exercises. Affected by data advancements, educating and learning happens in a changed circumstance. There appears to be a move from educator focused instructing to understudy focused learning. Menges (1994) expressed that the eight "shifts" of Collins (1991) mirror the impacts of data advances on educating and learning process. These movements put more noteworthy accentuation on the action of the understudies than on that of the teacher's.

#### **Creative tools for the teaching of statistics and probability**

The sorts of development used in bits of knowledge and probability direction can be broken into a couple of classes: Statistical programming groups, educational programming, spreadsheets, applets/free applications, charting calculators, intuitive media materials, and data stores. There is a lot of spread in the limits of the instruments over these portrayals, yet nobody contraption obviously covers all conceivable illuminating occupations of improvement (Ben-Zvi 2000; Biehler 1997). We give a brief once-over of the sorts of contraptions accessible and a touch of their focal points and weights. Different assets, for example, The American Statistician (<http://www.amstat.org/PUBLICATIONS/tas>)

or The Journal of Statistical Software (<http://www.jstatsoft.org>) routinely give continuously complete programming audits. The objective of this area is to give a flavor to the sorts of creative instruments open, featuring a section of the more regular events of every sort of hardware. Remember that the purpose of intermingling of course ought to stay on the substance and not the instrument, and to pick improvement that is normally sensible for the understudy learning objectives, which could consolidate a mix of types of progress. Since a new composing PC program is constantly being made for K-16 direction, the going with conversation doesn't endeavor to be cautious.

### Quantifiable software packages

Quantifiable packs are adjusting gotten ready for the express reason behind performing real assessments. Several gatherings have been utilized by agents for a long time, including SPSS (<http://www.spss.com>), S in any case (<http://www.insightful.com>), R (<http://www.r-project.org>), SAS (<http://www.sas.com>), and Minitab (<http://www.minitab.com>). While progress of these gatherings has concentrated on utilizes by industry, they have besides shaped into more menu-driven packs that are for the most part the more easy to use for understudies. The term menu-driven is utilized to depict a thing program that is worked utilizing record menus instead of requests. Menu-driven is usually less unpredictable for most clients as it permits the client to explore utilizing the mouse and to seek after and peck more, which has the two central focuses (understudies don't feel as lost) and loads (a significant part of the time utilizing an experimentation methodology instead of affirmed thought while picking a solicitation). As these packs become even more clear, they are if all else fails persistently utilized in at a perfect time courses.

The quantifiable gathering Minitab unequivocally has dependably had an academic obsession and is getting powerfully possible as a gadget that awards understudy assessment and improvement of thoughts (e.g., imparting "macros" for continued evaluating, plans that update in this way as information respects are joined or controlled, ease of propelling portrayals). Data Desk (Velleman 1998; <http://www.datadesk.com>) is a basically indistinguishable pack in any case has concentrated on information assessment and common plans from its shrouded improvement. Data Desk gives different wonderful contraptions that award understudies to search for plans, present sensibly point by point demands about the information, and 'talk' with the program about a specific game-plan of information. R (Verzani 2005) is a language and condition for quantifiable planning and structures that gives a wide assortment of unquestionable and graphical systems, including straight and nonlinear representing, honest tests, time game-plan evaluation, assembling, and packaging. It is uninhibitedly open and is if all else fails powerfully utilized in basic encounters classes. Additional things can be downloaded to improve the graphical interface of the program (<http://socserv.mcmaster.ca/jfox/Misc/Rcmdr>).

Even more financially sharp choices rather than these packs join understudy translations which are humbler in scope (doesn't work for as enormous of illuminating groupings) and several free genuine bundles are in like way now accessible limitlessly or at insignificant cost, on the web.

For instance, StatCrunch (West, Wu, and Heydt 2004), is an absolutely rational, especially unobtrusive, Web-based precise pack with a simple to-utilize interface and crucial quantifiable schedules fitting for enlightening essentials.

### Educational software

Various types of quantifiable programming programs have been become particularly for helping understudies learn estimations. Handle an versatile and dynamic mechanical assembly was organized with the commitment of various bits of knowledge educators and educational masters to help understudies with understanding reasonable thoughts and techniques in estimations, and doesn't attempt to have the limits of logically standard accurate programming gadgets. Erickson (2002) portrayed Fathom as an interesting PC learning condition for demonstrating data examination and estimations reliant on pulling, discernment, reenactment, and sorted out composed exertion. The most grounded features of Fathom are the basic access to different, associated depictions (see Figure 3), including sliders (see Figure 1), the ability to fabricate and run generations, and the a wide scope of techniques for acquiring data from an arrangement of sources.

Tinker Plots was made to help progressively enthusiastic understudies' evaluation of information and quantifiable contemplations (Konold and Miller 2005). This instrument has been broadly field endeavored in math classes in levels 4-8 in both the United States and different nations (e.g., Ben-Zvi 2006) with positive outcomes. Understudies can start utilizing TinkerPlots without information on ordinary charts or various information types, without thinking like factors or tomahawks. By wisely planning their information (referencing, stacking, and isolating information pictures), understudies a little piece at a time structure information to respond to their solicitations and genuinely plan their own frameworks.

Inspire Data is a business broadened sort of Table Top that in like way rotates around visual delineations in helping level 4-8 understudies "find essentials as they aggregate and research information in a pivotal interest process." This pack also offers related portrayals, improvements, and simpler comment of information evaluations and introductions.

A fragment of these edifying gatherings are moreover making it less hard for understudies to locate a decent pace records (e.g., Census information) and for teachers to locate a serviceable pace study passage works out. The restricted evident limits may prevent their utilization past a starting course (at any rate they are expanding, e.g., Fathom before long offers unmistakable lose the faith), yet has benefits in being less overpowering to the understudies and being consistently outfitted to the point-and-snap age.

### Spreadsheets

Spreadsheets, for example, Excel (<http://office.microsoft.com/>) are extensively open on different PCs. Regardless, care must be practiced in utilizing Excel as a certified instructive gathering. Inspectors as frequently as conceivable scold Excel's estimation calculations and decision of graphical shows (Cryer 2001; McCullough and Wilson 1999). For instance, it is as yet hard to make a boxplot in Excel. Outperform wants has a few qualities in helping understudies comprehend how to filter through information and in "adjusted resuscitating" of

figurings and diagrams as attributes are changed, and some benefactor Excel because of its extensive use in industry and passably fundamental access (Hunt 1996).

### Applets/stand-alone applications

Over the range of the most recent decade there has been superb headway in the improvement of on-line applets that can help understudies with inquiring about contemplations in a visual, smart and dynamic condition. An applet is a thing section that regularly plays out a compelled breaking point and runs reliably in a Web program. A basic number of the applets are essential for understudies to utilize and a significant part of the time get an intriguing "setting" for understudies, e.g., the Monty Hall issue (see for instance [http://www.shodor.org/interactivate/works\\_out/AdvancedMontyHall](http://www.shodor.org/interactivate/works_out/AdvancedMontyHall)), Sampling Reese's Pieces

(see for instance <http://www.rossmanchance.com/applets/Reeses/ReesesPieces.html>). Moreover, countless PC undertakings can be downloaded from the Internet and run without an Internet association that permit understudies to investigate a specific idea (e.g., Sampling SIM awards the understudy to look at testing distributions of test means and test degrees, wholeheartedly downloadable from:

[http://www.tc.umn.edu/~delma001/stat\\_tools/software.htm](http://www.tc.umn.edu/~delma001/stat_tools/software.htm)). While these contraptions are too unique to even consider evening consider evening consider posting here, the Consortium for the Advancement of Undergraduate Statistics Education (CAUSE, <http://www.causeweb.org>) gives a friend explored clarified once-over of such instruments. Applets can in like way be found with the online National Council of Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics Electronic Examples

(<http://standards.nctm.org/narrative/eexamples>). What these gadgets reliably gain in depiction and knowledge, they may from time to time lose in convenience. In addition, recollecting that they can be enthusiastically and effectively found on the Web, they are not routinely joined by point by control documentation and exercises toward manage understudy use. The time required for the instructor to get ability with a specific applet/application, close how to best concentrate on the bona fide considerations required, and make point by point rules and commitment for the understudies may not be as advantageous as from the beginning recognized.

### Charting calculators

Possibly the most smaller contraption and one that is when in doubt logically used in lower grade levels is the outlining calculator. A charting analyst is a learning gadget planned to help understudies with envisioning and better fathom thoughts in math, bits of knowledge and science (Dunham and Dick 1994).

Sorts of progress in headway have made the laying out investigator a unimaginable asset for looking at and exploring information. Information can reliably be downloaded from the Web, sparing understudies time from entering in information. A few models give an available procedure to understudies to collect and measure light, temperature, voltage, or advancement information, and altogether more. Different quantifiable estimations, including acknowledgment strategies and likelihood scatterings are straightforwardly standard in various brands.

Increases can in like way be run in a sensible time divide permitting understudies to look at considerations, for example, exploring developments. Understudy learning time is short with such advancement and schools can get one examination hall set for use at school or in a specific course. By and by, past the starting estimations course, they are not a sensible substitute for genuine packages. Understudies furthermore should be careful that the yield given by the outlining analyst isn't sufficient correspondence of authentic results (e.g., "calculator talk," graphs with no imprints and scales).

Five models and techniques for graphing calculator instrument use rose in an abstract science study corridor based assessment: computational mechanical assembly, transformational gadget, data collection and examination gadget, envisioning gadget, and checking gadget (Doerr and Zangor 2000). These pros similarly found that the use of the calculator as an individual contraption can control correspondence in a touch of social affair setting while its usage as a typical device maintained logical learning in the whole class setting.

### Blended media materials

These materials consistently hope to join a couple of unmistakable sorts of development. For example, Active Stats (<http://www.activstats.com>) is use in school homerooms, merging accounts of genuine occupations of bits of knowledge, littler than ordinary talks joined by development, associations with applet-like devices, and the ability to instantly dispatch an accurate programming pack and separate an instructive assortment. An ideal situation of such a circumstance is, that understudies simply need to learn one kind of development. In all honesty, to a consistently expanding degree, entire activities and in any event, perusing material are made around these sorts out of embedded advancement to make them a "living" course book, e.g., Cyber Stats. Different other mixed media assets are right by and by being made far and wide, two or three which were portrayed in the procedures of the International Conferences on Teaching Statistics (ICOTS-5, Pereira-Mendoza, Kea, Kea, and Wong 1998; ICOTS-6, Phillips 2002; ICOTS-7, Rossman and Chance 2006).

### Information and materials repositories

Another remarkable and basic utilization of the World Wide Web in estimations course is in finding and utilizing academically rich illuminating records and exploratory exercises for use with understudies (e.g., Schafer and Ramsey, 2003). Various information stores exist. The Data and Story Library (DASL, <http://lib.stat.cmu.edu/DASL>) and the Journal of Statistics Education (JSE) Dataset and Stories highlight (see [http://www.amstat.org/scatterings/jse/jse\\_data\\_archive.html](http://www.amstat.org/scatterings/jse/jse_data_archive.html)) are grand beginning spots. These informative records go with "stories" spreading out their experience and study passage vocations. CAUSE (<http://www.causeweb.org>) is again a fair asset for datasets and peer-evaluated study hall works out.

The different sorts of devices and assets recorded above offer exceptional decisions for instructors, also as choices about how to best utilize these contraptions, how ordinarily to utilize them, and for what purposes and exercises. While colossal amounts of the mechanical gatherings delineated are true blue examine devices, others have been grown on a

very basic level for learning purposes. We next break down issues identified with the employments of imaginative devices in helping understudies learn and reason about bits of information.

### How technology can support student learning

As logically progressively mechanical contraptions become open, and as understudy office with such instruments altogether assembles, it is getting continuously basic to focus on the best ways to deal with use such devices in the examination lobby. Underneath we give cases of a segment of the convincing livelihoods of advancement in the experiences study corridor. It is basic to recollect that countless these learning gadgets have different goals and it may be critical to use different instruments for different learning targets and that a mix may best guide understudies. In case using a blend of advances, it is basic to deliver desire to retain data issues for understudies. There's for each situation overhead in making sense of how to use a mechanical assembly itself before understudies can benefit by the gadget for learning experiences. Understudies do show up adjust at comprehending how to utilize various sorts of programming in a relative course yet instructors may in like way revolve around a legitimately strong look and feel, at any rate in the instructional associates they furnish for go with the devices, and to constantly give direction on when to utilize the various devices.

### Conclusion

Data innovations are the aftereffect of information blast. These incorporate equipment and programming advances and encourage showing learning process. Utilizing Information Technologies students are presently ready to partake in learning networks all through the world. They are autonomous and free in decision of their projects of study and access to the assets. They may adapt cooperatively, share data, trade their learning encounters and work through agreeable exercises in virtual learning networks. Data innovations encourage showing learning process in increasingly gainful design. So also, the job of instructor is likewise extraordinary in new settings than in the regular framework. Instructor encourages and controls the students in their examination assuming the job of a mentor or tutor. Presently instructor isn't at the focal point of the guidance and sole wellspring of data as in regular study halls. He/she chooses substance/encounters as well as exercises, finds the assets and aides students how to approach and use the data for required results. In nutshell, data innovations are rebuilding showing learning procedure to fulfill the International guidelines.

### References

1. Al-Radaideh Q, Al-Shawakfa E, Al-Najjar M. 'Mining Student Data Using Decision Trees', The 2006 International Arab Conference on Information Technology (ACIT'2006) – Conference Proceedings, 2006.
2. Ayesha S, Mustafa T, Sattar A, Khan I. 'Data Mining Model for Higher Education System', European Journal of Scientific Research. 2010; 43(1):24-29.
3. Baradwaj B, Pal S. 'Mining Educational Data to Analyze Student s' Performance', International Journal of Advanced Computer Science and Applications. 2011; 2(6):63-69.
4. Chandra E, Nandhini K. 'Knowledge Mining from Student Data', European Journal of Scientific Research. 2010; 47(1):156-163.
5. El-Halees A. 'Mining Students Data to Analyze Learning Behavior: A Case Study', The 2008 international Arab Conference of Information Technology (ACIT2008) – Conference Proceedings, University of Sfax, Tunisia, Dec, 2008, 15-18.
6. Han J, Kamber M. Data Mining: Concepts and Techniques, 2<sup>nd</sup> edition. The Morgan Kaufmann Series in Data Management Systems, Jim Gray, Series Editor, 2006.
7. Kumar V, Chadha A. 'An Empirical Study of the Applications of Data Mining Techniques in Higher Education', International Journal of Advanced Computer Science and Applications. 2011; 2(3):80-84.
8. Mansur MO, Sap M, Noor M. 'Outlier Detection Technique in Data Mining: A Research Perspective', In Postgraduate Annual Research Seminar, 2005.
9. Romero C, Ventura S. 'Educational data Mining: A Survey from 1995 to 2005', Expert Systems with Applications. 2007; 33:135-146.
10. Romero C, Ventura S, Garcia E. 'Data mining in course management systems: Moodle case study and tutorial', Computers & Education. 2008; 51(1):368-384.
11. Shannaq B, Rafael Y, Alexandro V. 'Student Relationship in Higher Education Using Data Mining Techniques', Global Journal of Computer Science and Technology. 2010; 10(11):54-59.
12. Sheikh L, Tanveer B, Hamdani S. 'Interesting Measures for Mining Association Rules', IEEE-INMIC – Conference Proceedings, 2004.
13. Sarkar Sukanta. The Role of Information and Communication Technology (ICT) in Higher Education for 21 Century. The Science Probe. 2012; 01:30-40, ISSN, 2277-9566.
14. Sandhu Kulbir Singh. Methodology of Research in Education. Delhi: Sterling Publishers Private Limited.
15. Pool, Lorraine Dacre, Pamela Qualter, and Peter J. Sewell. "Exploring the factor structure of the CareerEDGE employability development profile." Education+ Training. 2007; 56.4(2014):303-313.
16. Saranya S, Ayyappan R, Kumar N. "Student Progress Analysis and Educational Institutional Growth Prognosis Using Data Mining." International Journal of Engineering Sciences & Research Technology, 2014.
17. Hicheur Cairns, Awatef, *et al.* "Towards CustomDesigned Professional Training Contents and Curriculums through Educational Process Mining." IMMM 2014, The Fourth International Conference on Advances in Information Mining and Management, 2014.
18. Archer, Elizabeth, Yuraisha Bianca Chetty, and Paul Prinsloo. "Benchmarking the habits and behaviors of successful students: A case study of academic-business collaboration." The International Review of Research in Open and Distance Learning. 2014; 15.1.
19. Arora, Rakesh Kumar, Dharmendra Badal. Mining Association Rules to Improve Academic Performance, 2014.
20. Peña-Ayala, Alejandro. Educational data mining: A survey and a data mining-based analysis of recent works. Expert systems with applications. 2014; 41(4):1432-1462.

21. Vanhercke Dorien, Nele De Cuyper, Ellen Peeters, and Hans De Witte. "Defining perceived employability: a psychological approach." *Personnel Review*. 2014; 43(4):592-605.
22. Potgieter, Ingrid, Melinde Coetzee. Employability attributes and personality preferences of postgraduate business management students. *SA Journal of Industrial Psychology*. 2013; 39(1):01-10.
23. Jantawan, Bangsuk, Cheng-Fa Tsai. The Application of Data Mining to Build Classification Model for Predicting Graduate Employment. *International Journal of Computer Science and Information Security*, 2013.
24. Bakar, Noor Aieda Abu, Aida Mustapha, Kamariah Md Nasir. Clustering Analysis for Empowering Skills in Graduate Employability Model. *Australian Journal of Basic and Applied Sciences*. 2013; 7(14):21-28.
25. Zhang, Xiaolong, Guirong Liu. Score Data Analysis for Pre-Warning Students in University. *Wireless Communications, Networking and Mobile Computing, 2008. WiCOM'08. 4th International Conference on. IEEE, 2008.*
26. Zhao, Hua-long. Application of OLAP to the analysis of the curriculum chosen by students. *Anti-counterfeiting, Security and Identification, 2008. ASID 2008. 2nd International Conference on. IEEE, 2008.*
27. Villalon, Jorge J, Rafael A. Calvo. Concept Map Mining: A definition and a framework for its evaluation. *Web Intelligence and Intelligent Agent Technology, 2008. WI-IAT'08. IEEE/WIC/ACM International Conference on. 2008; 3:IEEE.*