

Enhancing Learning Experiences by Continuous Feedback, Assessment and Learning Analytics

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Abstract- A comparison between conventional learning and E-learning implies that the latter has improved strategies, which are effective in assisting learners to comprehend information. This paper identifies the learning patterns of the students by using feedback and learning analytics. The role of student feedback in the instructing and learning cycle is important. Student feedback represents the amplitude of practicable information which can be used to improve work or learning strategies for the proposed system. This paper analyzes the importance of student feedback in learning analytics. Big-data and Hadoop is used because of huge data. Also discuss why big -data is used in E-learning.

Keywords— E-learning, Learning Analytics, Assessment, Feedback, Big-data, Hadoop –multi-node cluster.

I. INTRODUCTION

Traditional learning was based on classroom learning which is depending on the instructor that is known as conventional education. A learning experience platform (LXP) provides a personalized, social, online learning experience for learners. E-learning is a form of online learning in which the instructor and learner use Information and Communication Technologies (ICT), which gives flexible ways of learning from anywhere, anytime, at their own place. The key to E-learning services are user management, course delivery, course organization, online assessment, question handler. All universities/Institutes collect various forms of feedback from students. The feedback from learners helps instructors to observe their strengths and weaknesses to make pertinent changes to their teaching and educational program to enhance learners learning. Learning analytics is regarding collecting traces which learners leave behind and use those traces to enhance learning. Learning analytics is to recognize learner who take part less appropriate to succeed academically and to permit targeted interventions to help them reach better result. Every time learner interacts with their academy, by logging into a virtual learning management system by submitting an online assessment, taking an online quiz or by visiting the library, learners leave digital traces behind. We can optimize teaching and learning by collecting and analyzing those digital traces. Big data in terms of E-learning industry is the data which is created by learners while they are taking an E-learning course or

training module. The other things we can do through LA omnipresent computing by tracking the Psychophysiological sensors for eye tracking, brain, gestures, and postures which provide a continuous flow of data. All such dimension facing provocation in the classroom because they are costly and individually placed sensors. And the other way would be to let students report on a particular situation of their learning in lectures. Learners need to be aware of the feedback, why it is important to do so. Feedback will help the instructor to understand the strength and weaknesses of the learner and according to that, the instructor can help the learner to enhance the performance.

The Learning Management System, social media, E-learning authoring tool, etc. which have been lay by the institute or the E-learning professionals to collect data. The word big data doesn't only put in the volume of data itself, but the single pieces of data which are being collected. These pieces of data can be analyzed to suggest institute or E-learning professionals the chance to decide how the learner is obtaining information, at what step, and to point any problems which may exist in the E-learning approach.

II. RELATED WORK

There are various researches and studies have been over the learning analytics for increasing the performance of the learner. And methods of collecting feedback from learner to instructors. Here is the some of the studies and use cases from other researchers are expressed in this section.

Actor	Challenges	Result
Admin	Analyze student feedback There are 100s or 1000s of comments in each course, which makes it tedious for the instructor to read these comments and then decide on which comments to acts upon to improve the learners learning experience.	The instructor can change their teaching style after finding out students' opinions over periods or repeat a part of the content that learners did not clear.
Learner	Monitoring individual learner's performance. Dividing learner work by selected feature such as year of study etc. Recognizing outliers for early intervention. Learners requiring extra support like: i) cannot concentrate for a longer time. ii) Not be able to learn things so easily. iii) Lack of confidence	It reflects on their achievements and patterns of behavior with others. Like monitoring, analyzing, and changing to optimize student performance. Students will be suggested with relevant learning resources by predicting learner's performance Knowledge modeling learners.

The questions were modified and originated from the literature on estimating tertiary teaching and learning. The questioner is administered online by the Centre for Teaching Excellence (CTE) at the end of every term. "FACETS" is designed to assemble learners' approach of the instructor and their learning event in the course. "FACETS" stands for "For Assessment of Continuing Excellence in teaching" [4]. Faculty members use the feedback in their FACETS reports to ratify their strengths and areas for enhancement. They reflect on their teaching and curriculum and take steps to improve their instructional strategies and course materials to create a more positive learning experience for future students.

Learner feedback to increase teaching and educational program is explained in the teaching and learning, continuous improvement cycle. It has four-step processes. I) The learner involvement in the course when the instructors deliver the course. II) The learner gives feedback on their experience which includes quantitative and qualitative data both. III) The instructor analyses the feedback. IV) Based on the judgement gained from the analysis the instructor re-develops the teaching approach and the educational program content.

Learning Analytics research has illustrated the possibilities of LA in distinguishing and observing cognitive-affective parameters and enhancing learner success. But most of it has been registered to online and digital learning environments whereas physical classrooms have largely stand outside the scope of such research. In this explained to join that gap by suggesting a learner feedback model in that they describe on the difficult or easy and engaging or boring side of their lecture.

In our proposed method, we have used learning analytics of the learner with the help of traditional data which is used for the detection of the learner's pattern of learning. On the basis of assessment assign by the instructor to the learner that can help to figure out where they are required extra attention or where they are lacking. Using big data, Institute collect data by observing learners activities which they leave behind. This will help to increase the success rate of the learners.

III. METHODOLOGY

1) Big Data role to analyze learning: Before the growth of Big Data, instructors had to depend on frequent tests and assessments to decide the progress of learners. Regularly, struggling individuals were recognized too late, and the work to grip would often require huge effort. But when Big Data started to expand in all type of industry, institute understood the opportunities for enhancing learning experiences. If we could appreciate learners' behaviors, activities, and observe similarity to their learning success or

failure, we could assist learner to become more victorious in their courses.

2) Industry-specific Big Data Challenges: From technical aspect, an important challenge in the education industry is to include Big Data from different sources and retailer and to use it on platforms which were not designed for the different data. From a practical aspect, instructors and institutions have to grasp new data management and analysis tools. On the technical side, there are challenges to combining data from distinct sources on various platforms and from different retailers that were not designed to work with one another. Big data utilized for academic purpose is a challenge because of privacy and private data protection.

3) How Can we Use Big Data in E-learning?

The best resource at your disposal is your LMS. The performance of your online learners during an eLearning course and their feedback afterward will tell you a lot about its effectiveness. The result of assessment provides data which indicates that how good your online learners can use what they have learned. From social media platform and course website we can gather Big Data. You're able to track traffic, conversions, and mentions, all of which tell you which E-learning courses are most successful. Big Data to provide certain patterns which we can use to decide the usefulness of online training activities, also the overall success of your e-Learning course.

- A. **Updating Your Online Training Content:** Use Big Data to analyze the demand of certain e-Learning courses over others. What makes one e-Learning course more popular? You can look to other systems to see other business issues that may require training to enhance performance. For example, your support systems may indicate that more support tickets are related to certain application. Therefore, your online training content should better train users on that app to improve productivity.
- B. **Individualizing Online Training Content:** By looking across the different learning elements within your E-learning courses, you can review the most successful learning tools. For example, find rectification in the middle of the number of e-Learning courses containing online simulations and those with higher assessment results. You should, therefore, focus on simulations as a key learning tool within your online training content. By looking into the data of individual online learners, or groups of online learners, and analyze their particular needs and strengths.
- C. **Providing Management Information:** Reporting to leadership about the success of e-Learning projects, systems, and training is at the heart of every L&D strategy. Focusing on learning analytics on gathering

data to assist defined KPIs can easily report to managers upon request. Even assign managers or supervisors with data analysis tasks to streamline the process.

4) Big data is transforming the education sector: Big data in the education sector is likely to offer numerous benefits to student and educational institutions. Big data in the education sector offers outstanding opportunities for educators to reach out and instruct learners in new ways. It will give them a deeper understanding of learners' education experience.

A. Big data in the education sector: Improve student result

The overall idea of leveraging big data within the educational system is to improve student results. Currently, the only measurement of the performance of students is the answers to assignments and exams. It is possible to monitor learner's actions that are how long learner takes to answer a question, which sources they use for exam preparation, which questions they ignore, etc. because of big data in education. These and similar to these questions can be answered automatically and instantly, giving each student instant feedback.

B. Big data in the education sector: Reduce dropouts

As big data in the education sector would help improve learner results, give-up at schools and colleges would also diminish. Educational institutions can use predictive analytics on all the data that is collected to give them insights on future learner outcomes. Those predictions can also help run scenario analysis on a course program before it is introduced into the curriculum; minimizing the need for trial-and-error. Big data can be used to monitor how learners are performing in the career market after graduating from college. This would also help learners in choosing the right college and course in future.

5) Integration of big data and E-learning systems

Big data have become key components of any information system, including e-learning systems. Their integration is a major necessity to free themselves from hardware and technical architecture installation issues and to take advantage of the important volumes of data generated by such a system, as well as to gain flexibility in processing and analysis. Identifying useful information from learning data is a big challenge; especially with the significant grow in the amount of data produced every day by online learning platforms. It is possible to prepare and analyze, in a distributed manner, large amounts of data to make the best decision and to help e-learning instructors to be able to continuously boost and improve their strategies to be adapted to the interests and learning of each learner.

The big data involves storage technologies and distribute large data, vast parallel computing, improved analysis, optimization, and visualization of the filtering results. It clusters together different big data technologies that can be

classified in:

- Distributed file systems: It stores data in multi-nodes cluster in a replicated manner to arrange redundancy and high availability. HDFS remains best open-source solution for distributed data storage and management.
- Distributed processing and predictive analysis infrastructure: It permits parallel computing of huge data sets across clusters. Hadoop is the greatest known open source of distributed systems which is generated by the Apache Foundation.

IV. PROPOSED WORK

The goal of this research work is to identify learners learning status or problems in delivering adaptive learning by analyzing their learning behaviour, learning analytics: learner's thinking power, performance knowledge, and learning pattern. Instructors by analyzing the behaviours like raising a question, examine information related to a specific issue, monitoring and comparisons, suggesting new ideas, or giving the correct answer. Based on mind map system architecture is prepared.

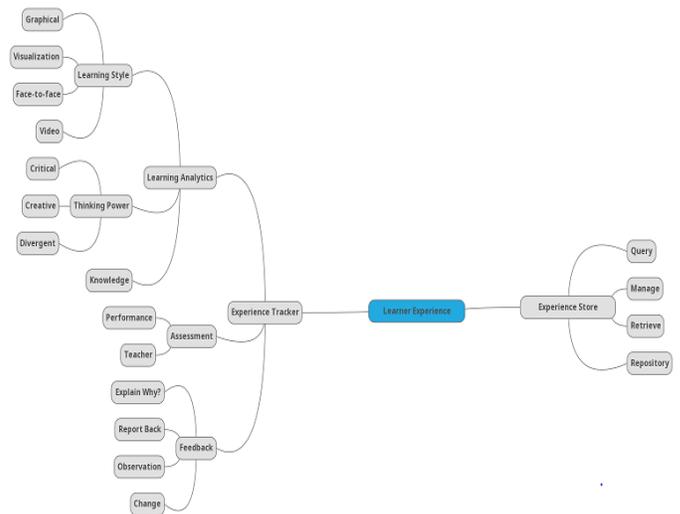


Figure 1: Mind-map

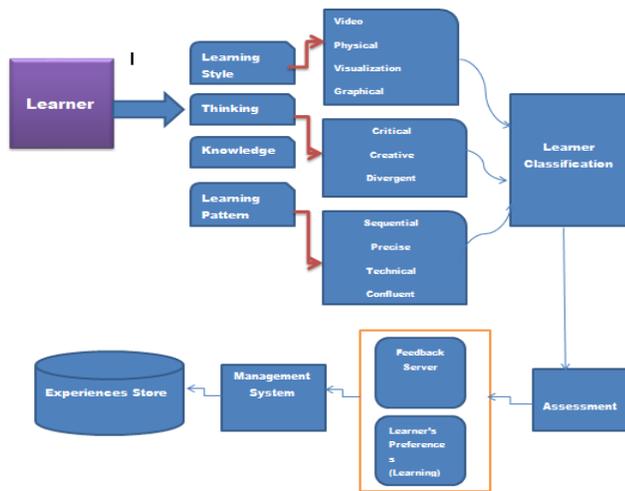


Figure 2: System Architecture

A. Experience tracker: The tracker is a method to collect learners’ expectations and experiences which helps to discover the pattern of the learning, thinking power, performance, learning style, knowledge level of the learner on the basis of the question they ask, assignment given to them to complete and the activities.

- **Thinking power:** Using your thinking power when you try to solve problems, ask questions, make decisions, make plans, and organize information. It is cognitive operations or process that is a building block of thinking.
- **Learning Style:** It is a process that a learner uses to learn. It can be defined, identified, classified in many ways which describes as a set of features, attitudes, and behaviors that promote learning for an individual in a given circumstance. By knowing a learner's learning style, an instructor can use instructing methods that maximize learner learning.
- **Pattern of learning:** Learning pattern that allows instructors and learners to discover, understand, and apply reality in their lives. This consists of the following fundamentals: Understand the context and content. Identify, understand and apply tenet and principles. Feel the truth and importance of tenet and principles.

B. Assessment: Instructor will assign some work to the learner that has certain criteria. And submit it to the instructor that will check that the learner has finished their work of their own or copied from someone else’s work. On the basis of assessment and feedback, it is analyzed that what is suitable content will be provided for learning.

C. Feedback: Learners will give feedback to the instructor on the basis of their teaching style, explanation of the topic, using examples while explaining the topic etc. Instructor will give feedback to the learner, how they learn the things, about the work completion etc. Being an effective at what you are doing needs feedback. Some of the used and effective ways to

grasp technology to provide feedback are:

- **Electronic Publishing:** With electronic feedback, learners can focus on and digest comments at a time of their choosing, in the non-attendance of their peers.
- **Computer Assisted Assessment:** Providing feedback during computer-based formative assessment activities can be extremely engaging. This is because learners are receiving on-the-spot feedback all over the learning activity. This technique has become more and more popular at all group levels.
- **Live Polling:** Research has introduced that classroom response systems – also known as “clickers” – generate a more powerful, interactive classroom experience. This results in increased appearance, engagement, and learning. Clickers are handheld transmission device like TV remote controls. They enable each learner to give real-time responses during teaching. These responses give teachers on-the-spot insight into how well learners are grasping the lesson. This then enables teachers to adjust the lesson and to provide appropriate feedback [19].

D. Experience store: It stores the feedback data and analyses it according to the requirement. It is handled by the administrator of the institute/University. Institute/University collects and loads the data in their server. To store the data Hadoop cluster is used because of large and increasing data.

A. Dataset

1) The file holds demographic information about the learners together with their results. The file holds the following columns:

Table 1: Student Information

code_module	pre_id	student	gender	region	highest_education	lmd_band	age	band	num_of_prev_attempts	studied_credits	disability	final_result
AAA	2013i	11391	M	Anglian Re	HE Qualification	90-100%	55+	0	240	N	Pass	
AAA	2013i	28400	F	Scotland	HE Qualification	20-30%	35-55	0	60	N	Pass	
AAA	2013i	30268	F	Western FA Level or Equivalent	30-40%	35-55	0	60	Y	Withdrawn		
AAA	2013i	31694	F	th East Regi A Level or Equivalent	50-60%	35-55	0	60	N	Pass		
AAA	2013i	33885	F	Midlands F Lower Than A Level	50-60%	0-35	0	60	N	Pass		
AAA	2013i	38053	M	Wales A Level or Equivalent	80-90%	35-55	0	60	N	Pass		
AAA	2013i	45462	M	Scotland	HE Qualification	30-40%	0-35	0	60	N	Pass	
AAA	2013i	45642	F	Western FA Level or Equivalent	90-100%	0-35	0	120	N	Pass		
AAA	2013i	52130	F	Anglian Re A Level or Equivalent	70-80%	0-35	0	90	N	Pass		
AAA	2013i	53025	M	orth Regi C Graduate Qualification	55+	0	60	N	Pass			
AAA	2013i	57506	M	outh Regi C Lower Than A Level	70-80%	35-55	0	60	N	Pass		
AAA	2013i	58873	F	Anglian Re A Level or Equivalent	20-30%	0-35	0	60	N	Pass		
AAA	2013i	59185	M	Anglian Re Lower Than A Level	60-70%	35-55	0	60	N	Pass		
AAA	2013i	62155	F	Western F HE Qualification	50-60%	0-35	0	60	N	Pass		

Description:

- code_module – recognition code for a module on which the student is registered.
- code_presentation - the recognition code of the presentation during which the student is registered on the module.
- id_student – a unique recognition number for the student.

- gender – the student’s gender.
- region – recognizes the region, where the student lived during taking the module-presenting.
- highest_education – highest learner education level on entry to the module presenting.
- imd_band– specifies the Index of Multiple Deprivation band of the place where the student lived during the module-presenting.
- age_band – a circle of the student's age.
- num_of_prev_attempts – the number times the student has attempted this module.
- studied_credits – the total number of credits for the modules the student is currently studying.
- disability – specifies whether the student has announced a disability.
- final_result – student’s end result in the module-presenting.

2) This file holds the results of students' assessments. If the learner does not give the assessment, there is no result recorded. The final exam submission is missing whether the result of the assessments is not stored in the system. The file holds the following columns:

Table 2 Student Assessment

id_assessment	id_student	date_submitted	score
1752	11391	18	78
1752	28400	22	70
1752	31604	17	72
1752	32885	26	69
1752	38053	19	79
1752	45462	20	70
1752	45642	18	72
1752	52130	19	72
1752	53025	9	71
1752	57506	18	68
1752	58873	19	73

Description:

- id_assessment – the recognition number of the assessment.
- id_student – a unique recognition number for the student.
- date_submitted – the date of student submission, measured as the number of days since the start of the module presenting.
- score – the student’s score in this assessment. The scale is from 0 to 100. The result lower than 40 is explained as Fail. The marks are in the result from 0 to 100.

B. Proposed model

The Hadoop multi-node configuration is done in a distributed environment consisting of three nodes. The Hadoop master node named Namenode1 of IP address 10.128.0.17 which contains the components like Resource

Manager and NameNode. The Hadoop master runs to processes to manage and coordinate cluster task and services. The other nodes in the cluster are workers, which are responsible for executing the operations or the basic jobs. Workers nodes provide resources to the cluster to perform the processing of the data assigned by the master node. The cluster topology is shown in the figure 3.

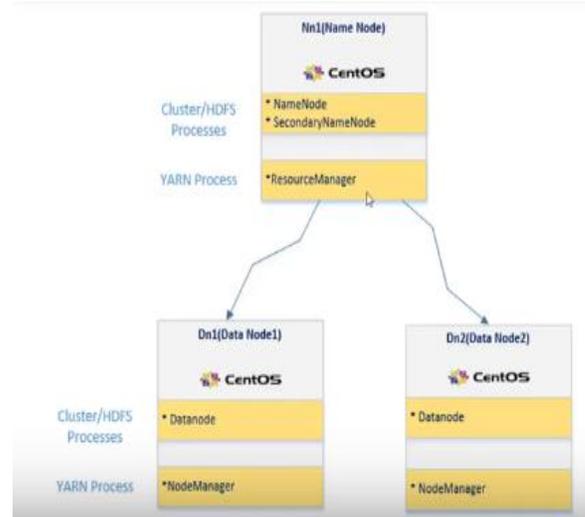


Figure 3: Cluster Topology

To build our big data infrastructure, following are the steps to prepare our cluster shown in figure 4.

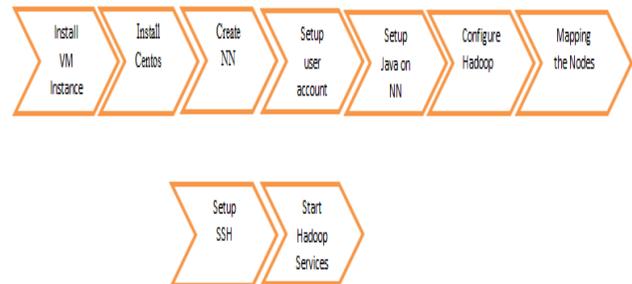


Figure 4: Steps to build cluster

We have prepared three nodes of cluster on VM instances on Google Cloud Platform by installing CentOS 6 operating system on each node of the Hadoop cluster. The capacity and configuration of all VM instances are described in the table 1.

Table 3: Configuration of all the nodes

Machines	Zone	IP Address	Core	Memo ry	Disk
Namenode 1	Us-central 1-a	10.128.0.17	2vCPU	7.5GB	40GB

Datanode1	Us-central-1-a	10.128.0.18	2vCPU	7.5GB	30GB
Datanode2	Us-central-1-a	10.128.0.19	2vCPU	7.5GB	30GB

After configuring the VM cluster network. We download, unzip and install the Java jdk8, Hadoop 2.7.0 and Hive 2.3.7 at the master node of the cluster. Then we moved the installation folder of both frameworks to the workers nodes using SSH protocol. A password free ssh has configured between the nodes. Now the Hadoop master node can stop, start, connect and run task in different workers.

Overview 'namenode1:54310' (active)

Started:	Fri Aug 21 14:07:07 UTC 2020
Version:	2.7.0, r94c8e494203c934e8074031239e2374c0842cf
Compiled:	2019-04-10T16:40Z by jenkins from (detached from 04c8e44)
Cluster ID:	CID:d06cecc-5c76-4e97-9e50-c297ccc80a0
Block Pool ID:	BP-721058001-10.128.0.17-1597701906841

Summary

Security is off.	
SafeMode is off.	
14 files and directories, 0 blocks = 14 total filesystem objects.	
Heap Memory used 49.66 MB of 174 MB Heap Memory. Max Heap Memory is 639 MB.	
Non Heap Memory used 36.49 MB of 37.5 MB Committed Non Heap Memory. Max Non Heap Memory is -1 B.	
Configured Capacity:	78.49 GB
DF8 Used:	56 KB (0%)
Non DF8 Used:	9.87 GB
DF8 Remaining:	69.62 GB (87.43%)
Block Pool Used:	56 KB (0%)
Datanodes usages% (Min/Median/Max/stdDev):	0.00% / 0.00% / 0.00% / 0.00%
Live Nodes	2 (Decommissioned: 0)
Dead Nodes	0 (Decommissioned: 0)
Decommissioning Nodes	0
Total Datanode Volume Failures	0 (0 B)
Number of Under-Replicated Blocks	0
Number of Blocks Pending Deletion	0
Block Deletion Start Time	8/21/2020, 7:37:07 PM

Figure 5: Summary of the cluster

C. Tools

Hadoop: Apache Hadoop is a open-source software which assists using a network of numerous computers to resolve issues requiring huge size of data and computation. It gives a software substructure for distributed processing and storage of big data utilize the MapReduce programming model. At first, it is configured for computer clusters built from commodity hardware which is still in use. And also establish on clusters of higher-end hardware. HDFS (Hadoop Distributed File System) involves storage part in Hadoop and a processing part which is a MapReduce programming model. The data is transmitted over nodes in the cluster done by Apache Hadoop which distributes files into big chunks. To operate the data in parallel it transfers collection of code to nodes [20].

Hive: Apache Hive is a data warehouse software. Hive runs on the top of the Hadoop for analysis and data querying. To query data stored in the different databases, hive provides interface like SQL. And file systems is combined with Hadoop. Hive gives the mandatory SQL abstraction to combine SQL like queries called Hive QL into the underlying JAVA without need to implement queries in the low level Java API. So, data warehousing applications works with SQL based querying language.

V. RESULT

To analyze the learners lean and instructors teaching methods we required huge data. Data is collected by the institutes/ universities using the activities which learners leave behind and those data are collected and stored in the repositories like Hadoop cluster because of increasing the data day-by-day. Due to increasing the data, it is not possible to store and analyze it in a single node for that we required Hadoop with multi node cluster so that it can be easy to upload data, query and retrieve the data which is handled by the authorized person.

A. Upload Data: To upload data in hive, we will upload the data to Hadoop cluster by using the command “hdfs dfs –mkdir –p assessment (name of the folder)”. Now by using ‘-put’ command “hdfs dfs –put assessment.csv (file name with extension) and the path.

```
[hduser@namenode1 opt]$ hdfs dfs -ls /user/hduser
20/08/18 20:32:27 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Found 1 items
drwxr-xr-x - hduser supergroup 0 2020-08-18 20:32 /user/hduser/assessment
[hduser@namenode1 opt]$
```

To upload data in Hive we need to create a table in hive by using: create table if not exists assess; to load data in the table” load data inpath '/user/hduser/assessment/assessment.csv' into table assess;”

```
hive> create table if not exists assess(code_module string, id_assessment int, assessment_type string, weight int)
> row format delimited
> fields terminated by ','
> lines terminated by '\n'
> stored as textfile;
OK
Time taken: 0.692 seconds
hive>
```

B. Query: Query is a request for data or information from table. We have fired some query. Queries can be fired according to the requirement.

```
hive> describe assess;
OK
code_module      string
id_assessment    int
assessment_type  string
weight           int
Time taken: 0.102 seconds, Fetched: 4 row(s)
hive>
```

```
hive> SELECT id_assessment, assessment_type FROM assess ORDER BY id_assessment;
```

Output:

```
NULL      assessment_type
1752      TMA
1753      TMA
1754      TMA
1755      TMA
1756      TMA
1757      Exam
1758      TMA
1759      TMA
1760      TMA
1761      TMA
1762      TMA
1763      Exam
14984     TMA
14985     TMA
14986     TMA
14987     TMA
14988     TMA
```

CONCLUSION

This paper has clarified the manipulation of big data in the educational domain. This has been concluded by using Hadoop and SQL. Learner and instructor dissatisfaction with feedback activity shows the requirement for better approaches for new ways of thinking. Learning analytics is a subject of an educational industry; we had discussed methodology like big data, Hadoop, and google cloud. The feedback literacy is used for the development of the student's best position and performance, also to judge their work and increase their learning. To predict the performance of the student or to check the level of knowledge and according to that guide will be allocated to the increase in the performance for better results. Targeting effective E-learning strategies and E-learning goals, and tracking learner patterns and expanding our understanding of the E-learning process.

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