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A Comparative Study of Social Network Mining of Massive Open Online Courses to Create an Open Course Module Structure.

Binu Mol T. V.[1*]

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Abstract: The review on various online courses, E-learning, Massive Open Online Course (MOOC) gives a static methodology for preparing the content. It gives hardship for the teachers to create a content for a topic. Study on Information and Communication Technology (ICT), Flipped classroom learning and models done to select what type of flipped classroom to be followed. Technologies present for Flipped classroom reveals which technology can be done in the case. Data mining techniques for e-learning studied to select which web mining method to select creating contents. Study on IoT sensors done to how to use IoT in selecting content for course for a module and language for creating source code and algorithm. Analysis of visualization tools for IoT enabled to select the tool for development. The study helps to initiate a method to create open course module structure from social network mining for e-learning which will help educators to easily create e-learning modules.

Keywords: e-Learning, Flipped, ICT, IoT, java, literature study, MOOC, open source, compilers.

INTRODUCTION

Analysis of most wanted courses can be done by checking no of enrolments in the courses and according to that an easily deployable open course can be created. As part of the problem a survey of various issues, challenges and techniques used in Social Network Mining for E-Learning evaluation strategy or Flipped Classroom Pedagogy is done. Also, a study on previous research and ongoing research on E-Learning, massive open online course (MOOC), Flipped classroom Pedagogy, social network mining and Unstructured Data mining have been done.

In the modern world, it is true that highly specialized education has got its own importance. The scope and demand for higher education is constantly increasing. The new pattern involves the creation of intellects of world standard and training of skilled manpower on a mass basis without compromising on quality (and that means making quality an integral part of the working of institutions of higher education). The world will be looking for trained persons in all basic fields with a sound knowledge base in their core discipline and with the ability to adapt to new demands. All domains of knowledge cannot do without **Information and Communication Technology (ICT).**

LITERATURE REVIEW

What is ICT?

"Information and Communication Technologies are defined as all devices, tools, content, resources, forums, and services, digital and those that can be converted into or delivered through digital forms, which can be deployed for realizing the goals of teaching learning, enhancing access to and reach of resources, building of capacities, as well as management of the educational system.[20]"

The use of ICT is motivating for the students as well as for the teachers themselves. It also improves the quality of education by facilitating learning by doing, real time conversation, delayed time conversation, directed instruction, self-learning, problem solving, information seeking and analysis, and critical thinking, as well as the ability to communicate, collaborate and learn.

Teaching and learning of certain subjects can be revolutionized by integrating ICT tools:

Mathematics is an excellent example. By using free software's like **Scilab,** Python, LATEX mathematics can be presented visually and there is a great opportunity to completely revolutionize mathematics education (BOS in Mathematics should lead this transformation to visual mathematics).

E-Learning

E-Learning allows higher participation and greater interaction. It challenges the concept that face-to-face traditional education is superior to it. The web and the Internet is the core ICTs to spread education through e-learning.

Corresponding Author: *Binu Mol T.V*
[*] *Assistant Professor,Department of Computer Science, KKTM Govt.College, Pullut,Thrissur,Kerala, India,binumol3@yahoo.com*

India is making use of powerful combination of ICTs such as open source software, satellite technology, local language interfaces, easy to use human-computer interfaces, digital libraries, etc. with a long-term plan to reach the remotest of the villages.

The pandemic CORONA virus issued so many challenges that teachers all over the world forced to go behind e-learning. The following are some of the orders issued in Higher Education.

[1] As part of preventive measures to achieve "social distancing" teachers are asked to work from home up to 31/03/2020 and utilize this period for various activities like:

Development of online content, online teaching, and online evaluation.

Prepare innovative questions for "Question Bank."

Preparation for next semester.

2. [2] Let COVID -19 not stop us from learning by engaging in **On-line learning** using ICT initiatives of MHRD and UGC
3. [3] Give online class and assignments using any electronic media
4 Conduct online internal exams
5. Create question bank
6. Develop a MOOC course.

"While higher education policies focus on placing students at the heart of the education process, the propensity for student identities to shift from partners in learning to consumers of education provides challenges for negotiating the learning experience" [5].

Flipped Classroom Pedagogy

"[4] The properties of this approach which its English correspondence is "Flip" are explained like this by referring first letters:

F ("F"lexible Environment): It indicates provision of time and place flexibility of learning.

L ("L"earning Culture): In traditional teacher centered approach the source of knowledge is teacher. In flipped classroom approach there is transition from teacher centered approach to student centered approach.

I ("I"ntentional Content): Flipped classroom educators both think about how education is used to provide fluency and how they can develop cognitive understanding of students.

P ("P"rofessional Educator): The responsibility of flipped classroom educators is more than the ones using traditional approach. Flipped classroom educators continuously observe students during the course, evaluate their studies and make feedbacks (Flipped Learning Network -FLN, 2014). "

Technology of the flipped classroom

"[4] Faculties prefer to make their own videos. Equipment's that are necessary to form and broadcast lecture videos, are presented below:

Video forming equipment's: Screen-Cast-O-Mattic, Camtasia PC, TechSmith Relay, Office Mix, Adobe Presenter.

Video Hosting: After forming the video, it should be placed online for access of students. Some of video sites are YouTube, Teacher Tube, Screencast.com, Acclaim, Google Drive.

Video interaction Software's: These are software's that provide teachers to access some information such as which student watched which lecture video, how long he watched, how he answered the questions in the video. Some software's that can be given as example are; EduCanon, EdPuzzle, Zaption, Office Mix, Verso, TechSmith Relay, Adobe Presenter, Google Apps for Ed.

Learning Management: As created videos can be sent to video hosting site, they can be presented to access by using learning management system (LMS). LMS are not only broadcast videos, they can also provide interaction with students. Moodle, Sakai, Blackboard, VersoApp, Schoology, canvas, My Big Campus, Haiku Learning, Google Classroom can be given as examples for learning management systems (LMS).

Flipped classroom models

''Traditional Flipped Classroom Model:

It says that "what is done at school done at home, homework done at home completed in class".

Partial Flipped Classroom Approach Model

It is not strict as Traditional.

Holistic Flipped Classroom Model

Here we use learners at home, use mobile or computer and physical classrooms synchronously. A log is kept for all activities.[6]". A traditional holistic or partial flipped class model can be done by using the proposed open course module structure. All this will help in increasing the interaction.

"Research indicates that higher education institutions have not been able to fulfill their role in fostering critical thinking, effective interpersonal skills, or reasoning skills—the core competencies intended to be instilled in students" [7].

"Unfortunately, findings from research on student attention indicate that the average attention span of a student is less than 20 minutes, which results in reduced engagement and interactions, and, in effect, highly ineffective use of time for learning" [8]. Hence this model will incorporate only videos up to 20 minutes.

In paper [7], the authors ask to incorporate lab sessions along with theory sessions. So, the model will incorporate open source compilers to do programming labs.

"Downloading frequency refers to the number of times for the same material being downloaded. Students who gave reasons for not downloading the materials frequently for self-study are no WIFI or insufficient mobile traffic.

With the aid of QQ and Wechat, teachers and students can upload and download materials quite freely and can have discussions freely. With QQ or Wechat as a communication platform, who downloaded the material and who didn't are unknown because the actual users' names are not shown when downloading took place; what's shown is the total downloading frequency of a material.[9]"

Here we can use Open source software PyCA a fully functional opencast capture agent or Cam studio. open-source web conferencing tool Jitsy can be used for web conferences.

"The Learning Management system (LMS) "Moodle" [8] was selected both for managing the course and as example to be used within the course. It is an open source program, free to use in education and the source code is available on the internet.[10]. All material that was needed in the process is, The LMS Moodle, Instructional videos and texts, Sumatra PDF, VLC media player, LyX, HotPotatoes 6, AbiWord, MoWeS, Portable II, OpenOffice is freely available on the internet.

In many rural areas to enable the participants to work without internet access the material above was downloaded and copied to 4 Gb USB-memory sticks. All programs were executed from the memory, allowing everyone to try out different settings and modifications in the LMS. Throughout the course everyone had their own USB-memory and the idea was that no one should be dependent on access to internet, or even access to a particular computer. Whenever a computer is available one can start up the LMS from the USB-memory and work on the assignments or study the instructional material. Between sessions all work is saved in the USB memory." So here all open source tools for the LMS are executable from one USB memory.

What is a MOOC?

MOOC stands for Massive Open Online Course

"An online phenomenon gathering momentum over the past two years or so, a MOOC integrates the connectivity of social networking, the facilitation of an acknowledged expert in a field of study, and a collection of freely accessible online resources. Perhaps most importantly, however, a MOOC builds on the active engagement of several hundred to several thousand "students" who self-organize their participation according to learning goals, prior knowledge and skills, and common interests.[11]

M (Massive): mass registration on courses with enrolment in some cases exceeding 1,00,000 students.

O (Open): anyone can enroll in a MOOC, in order to take advantage of these widely available Open Educational Resources (OER). Registration for most MOOCs is open, although some MOOCs have pre-requisites, and for-fee registrations, examinations, or certificates of completion.

O (Online): Typically, there is no requirement for face-to-face attendance by a student when they are enrolled in a MOOC.

C (Course): the concept of a pedagogically designed learning journey.

Brief History of MOOCs

The history of MOOCs has been described as a rapid evolution, short in timescale, and still evolving.

It can be traced back to 2008 when Stephen Downes and George Siemens launched "Connectivism and Connective Knowledge/2008" (CCK8), a four-credit course at the University of Manitoba, Canada. The course pushed the boundaries of connectivism with Siemens and Downes (2011) utilizing a range of platforms from blogs, forums, and wikis to Facebook groups.
With over 2,200 registrations, this allowed learners to be part of a large, organic but interconnected learner community, while independently maintaining their own personal learning environments (PLEs) (Siemens 2013). In response to this event, Dave Cormier (University of Prince Edward Island) and Bryan Alexander (National Institute for Technology in Liberal Education) coined the term "MOOC" or Massive Open Online Course.

First MOOCs:

2007: social media & Open Education

2008 & 2009: Connectivism

2010: Personal Learning Environments Networks and Knowledge

2011: Learning and Knowledge Analytics

2011: First MOOC in the US: Jim Groom and Digital Storytelling at the University of Mary Washington

2011: Stanford University: Machine Learning, Introduction to Artificial Intelligence, and Introduction to

Databases. The course on artificial intelligence had 160,000 students. Resulted in the creation of Udacity.

2011: edX launched through MIT

2012: Coursera founded by computer science professors Andrew Ng and Daphne Koller from Stanford University

MOOC Structure

MOOCs offer students the chance to take courses from celebrated specialist presenters, without any required course prerequisites. They are presented over a set length of time, just as regular classes are, and follow a set syllabus. Students are provided videotaped lectures accompanied by weekly homework problem sets, online resources, online reading lists, practice questions, midterms and final."

"The problem of learning resource mention identification in MOOC forums, i.e., to identify resource mentions in discussions and classify them into pre-defined resource types. As this is a novel task with no publicly available data, we first contribute a large-scale labeled dataset-dubbed the forum resource mention (FoRM) dataset-to facilitate our current research and future research on this task [12].

Two major challenges that hinder the applications of sequence tagging models to the task: (1) the diversity of resource mention expression and (2) long-range contextual dependencies. We address these challenges by incorporating character-level and thread context information into an LSTM-CRF model."

Web log dataset can be made available from many resources. In this proposal I try to investigate the number of enrolments in each course in a MOOC and find which course is most wanted according to that an open course module structure can be created.

Data Mining

"Nsofor (2006) explored nature of the different datasets in different domains and defined their unique qualities with the aim of appropriately using the right prediction technique in making predictions as shown in the Table 1.

Table1 Data Mining Techniques

Input	**Data Mining Techniques Used**		**Output**
Web Mining	Query provided by user, Learner usage and interaction Data	Association mining, Clustering	Topics ranked based on their relevance to user input, Usability studies, Patterns for website improvement and Network Traffic Analysis

Types of Web Mining

1. Web content mining

2. Web structure mining

3. Web usage mining, which is the process of discovering meaningful patterns from data generated by client-server transactions stored in web logs. Hence, web usage mining is the process of finding out how user uses the Internet "[12]. We can use web content and web usage mining.

"On the basis of the definition of data mining and the definition of data mining functions, a typical data mining process includes the following steps :

(i) Data preparation: prepare the data for mining.

It includes 3 substeps:

1 integrate data in various data sources and clean the noise from data;

2 extract some parts of data into data mining system;

3 preprocess the data to facilitate the data mining.

(ii) Data mining: apply algorithms to the data to find the patterns and evaluate patterns of discovered knowledge.

(iii) Data presentation: visualize the data and represent mined knowledge to the user.

We can view data mining in a multidimensional view.

(i) In knowledge view or data mining functions view, it includes characterization, discrimination, classification, clustering, association analysis, time series analysis, and outlier analysis.

(ii) In utilized techniques view, it includes machine learning, statistics, pattern recognition, big data, support vector machine, rough set, neural networks, and evolutionary algorithms.

(iii) In application view, it includes industry, telecommunication, banking, fraud analysis, biodata mining, stockmarket analysis, text mining, web mining, social network, and e-commerce .

Data Mining Functionalities

Data mining functionalities include classification, clustering, association analysis, time series analysis, and outlier analysis.

(i) Classification is the process of finding a set of models or functions that describe and distinguish data classes or concepts, for the purpose of predicting the class of objects whose class label is unknown.

(ii) Clustering analyzes data objects without consulting a known class model.

(iii) Association analysis is the discovery of association rules displaying attribute-value conditions that frequently occur together in a given set of data.

(iv) Time series analysis comprises methods and techniques for analyzing time series data in order to extract meaningful statistics and other characteristics of the data.

(v) Outlier analysis describes and models regularities or trends for objects whose behavior changes over time [19]"

Previous Similar Researches

[13] There has been similar related work in using web data to build adaptive e-learning site which is given in Table 2.

Table 2 Similar Precedents (2009 to 2014)

Authors	**Objective**	**Platform**	**Data Mining Task/ Adaptability Parameter**
Cristóbal Romero, et. al. (2009)	Proposes architecture for a personalization system to facilitate Web mining.	AHA – open Source general Purpose adaptive hypermedia system.	Clustering
Wanga Feng-Hsu, et. al. (2004)	Proposes a new clustering method called HBM (Hierarchical Bisecting Medoids Algorithm) to cluster users based on the time framed Navigation sessions	E-learning	Clustering, Association Mining
Cristóbal Romero et. al. (2013)	Proposes the usage of different data mining approaches for improving prediction of students' final performance based on participation indicators in social network Forums.	On-line discussion Forum	Classification and Clustering
Despotović Marijana et al. (Aug 2013)	Providing adaptability in Moodle LMS Course	Moodle-an Open Source Course Management System	Clustering on Learning style at the end of each PDCA cycle
Ghauth Khairil Imran et al. (2011)	An empirical Investigation of learner performance in e-learning	131 Power Point slides prepared by a course author for teaching XML	Good Learners' Rating by Prediction
Ms. Renuka Mahajan, 2014	Mining and Mapping the Web Data to build Adaptive e-Learning System	Layout of course can be reorganized to better suit learner's needs. Suggest topics to improve the performance based on online assessment results	Prediction

"Here synthesis of many research areas like data mining, personalization, recommendation systems and adaptive e-Learning systems. The personalization task is basically a prediction problem i.e. the system should be able to predict the area of interest of the users, specific content and then their ranking (Brusilovsky and Millán, 2007). In personalized adaptive e-learning systems, adaptability is the ability to modify existing course materials on the basis of different learner parameters. The main idea of adaptive e-learning systems is that, based on the learner characteristics, an appropriate adaptation method should be chosen, to adapt the presentation of the course material to the individual learner. Data mining has become an important tool for extracting data by establishing patterns. These patterns are analyzed to produce useful information required for decision-making. The pattern discovery algorithms are the most suitable for this task. They generate aggregated user models for predictive analysis on the basis of navigation profiles of past users. Authors Hill and Lewicki (2006) defined statistical analysis as the collection, analysis, interpretation and presentation of data. Statistical analysis is widely used in analyzing the empirical usage of a web site (Hung et al., 2012). Prediction is basically the construction of a model to assess the value(s) a variable is likely to have. Wang et al. (2009) use the predictive techniques to predict the relationship of various factors that affects student's learning and accordingly the teachers could adjust their teaching strategy. Many adaptive e-learning systems have evolved since 1996. These findings are given below in Table3 and have led several scholars to develop software applications that provide adaptive features as reviewed by Roy and Roy (2011)."[13]

Table 3 Adaptive e-learning

Author/Year	**Adaptive e-Learning System**	**Approach**
Brusilovsky And Weber (1996)	ELE-PE	An educational example for learning LISP.
Hockemeyer et al. (1998)	A Relational Adaptive Tutoring Hypertext (RATH)	Uses a mathematical model for structure of hypertext document utilizing the theory of knowledge space.
Henze and Nejdl (1999)	KBS- Hyperbook	Present the adaptation techniques on the basis of goal driven approach.
Weber and Brusilovsky (2001)	ELM adaptive remote tutor	It eliminates the limitations of ELE-PE and present learning materials online using an adaptive interactive textbook.
Shang et al. (2001)	An intelligent Agent for active learning.	Uses students' profile e.g. his learning style; background knowledge and the competence level in choice and presentation the learning materials.
Murray (2003)	Metalinks:An authoring tool	The pages traversed by a user are tracked by the system.
Fouad et al. , (2010)	An adaptive e-learning system	It is uses fuzzy clustering approach.
De Bra et al. (2006)	Adaptive Hypermedia for All(AHA)	Builds a model of preferences and knowledge of a user. It uses this information to adapt.

"Our work is done in the context of a real website where impact of learners' usage patterns can be investigated for building an adaptive e-learning site. These research findings can be potentially useful to other e-learning sites, facing similar challenges. This study addresses above stated objectives by examining a case study based on an e-learning framework designed for students from classes' sixth to tenth.

In the future, we would like to carry out experiments, using larger numbers of students from various courses, in different websites. More information about the students' profiles can be exploited in order to do clustering. It is possible that there might be some learner characteristics which are not available in the existing database that could be important indicators of their engagement e.g. learning styles, student demographic data etc.”[13] . In my proposal, several MOOC sites is to be visited and framework to be designed for higher education.

“Developing a Social web sites Network Extraction system that will be using multiple Groups communities, user profiles that may be multi-relational in nature, and to test them on real data logs based on spectral and temporal considerations where possible. Intelligent sensors can be used to perform deductive inference by sensing the environment and by applying temporal rules for effective decision making.” [14].The proposal tries to introduce IOT intelligent sensors for more decision making.

Unstructured data

“Unstructured data is data that has no specific format and no data model. Text data, image data and video data are some of the examples of unstructured data. With the increasing popularity of open-source platforms, software data is easily available from various open-source tools like GitHub, CVS, SVN, etc. More than 80 percent of the data present in them is unstructured Mining data from these repositories helps project managers, developers and businesses, in getting interesting insights. Most of the software artifacts present in these repositories are in the natural language form, which makes natural language processing (NLP) an important part of mining to get the useful results. The paper reviews the application of NLP techniques in the field of Mining Software Repositories (MSR). NLP is a computerized approach to analyze, understand and find the meaning of text free of natural language. It analyses the various aspects of language and helps about the questions related to why, who, where, whom and how. It includes many techniques like part of speech (POS) tagging, semantic dependency graph representation of text, named entity recognition, word sense disambiguation, parsing, etc.‘‘how much information should be added to a summary?’’, ‘‘how should a summary be evaluated?’’, etc. are still open questions in this field of research. [15]”.Here Iot can be referred and select information’s to be included in a summary.

“Most of the source code summarization techniques are focused on C and Java languages [15]”. Java can be selected for source code summarization technique.

“DM techniques for IoT need to be able to adapt to dynamic environments or changed data streams to avoid redesign of the DM rules each time a sensor is added or removed. Machine Learning (ML) techniques are well suited to handle the fuzziness in data streams and can adapt quickly when the environment changes. ML is a branch of Artificial Intelligence (AI) and aims to imitate human learning on computers without the need to be explicitly programmed. The research structure I of classification is shown below [19]”.

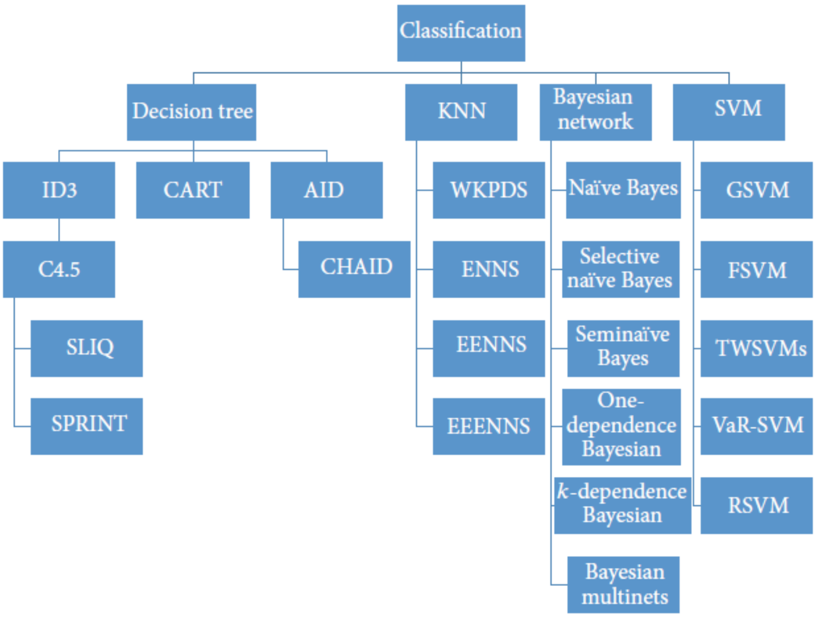

FIGURE 2: The research structure of classification.

“In this paper, we examine the applicability of eight well-known data mining algorithms for IoT data. These include, among others, the deep learning artificial neural networks (DLANNs), which build a feed forward multi-layer artificial neural network (ANN) for modelling high-level data abstractions. Our preliminary results on three real IoT datasets show that C4.5 and C5.0 have better accuracy, are memory efficient and have relatively higher processing speeds.ANNs and DLANNs can provide highly accurate results but are computationally expensive.

C4.5 tops among all the eights algorithms is terms of the classification accuracy, followed closely by C5.0[17]". Hence C4.5 algorithm can be considered for IoT data.

IoT

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. "IoT forms a Mobile Ad hoc Network(MANET) of connected things. Things in terms of IoT are everyday objects such as sensors, actuators, Internet enabled mobile devices, cars, household appliances or wearable devices. They provide ubiquitous sensing enabled by Wireless Sensor Network (WSN) technologies . IoT cannot only connect physical devices but also services or other data sources to form the Internet of Everything(IoE)[19]".

The massive data generated by the Internet of Things (IoT) are considered of high business value, and data mining algorithms can be applied to IoT to extract hidden information from data. In this paper, we give a systematic way to review data mining in knowledge view, technique view, and application view, including classification, clustering, association analysis, time series analysis and outlier analysis. And the latest application cases are also surveyed. As more and more devices connected to IoT, large volume of data should be analyzed, the latest algorithms should be modified to apply to big data.We reviewed these algorithms and discussed challenges and open research issues. At last, a suggested big data mining system is proposed [16]".

"IoT Analytics Tools:

Some of the tools which achieve greater visualization & Insights are:

1. **Tableau**

Tableau is an Internet of Things analytics tool that ingests and processes rows of data quicker than many other programs. Users will see up to five times quicker query speed, as well as three times faster extract speed.

2. **sqlDashboards**

TimeStored's Internet of Things analytics tool, sqlDashboard, is simple, affordable, and powerful. The process of analyzing your IoT assets is as simple as: Capturing the real-time data from your server connections Entering your specific query.Transforming your data into accessible charts for IoT insight

3. Power BI

Microsoft's data analytics and visualization tool, Power BI, is simple to use and can help your business extract valuable insights from your Internet of Things data.

The software collects information from hundreds of compatible sources (including your IoT devices and sensors) and can prep and model your information for immediate analysis within a few clicks.

With its friendly user interface, fast processing power and data visualization tools, Power BI is a powerful asset for the financial sector.

For instance, say you're a commercial bank trialing new 24/7 'smart ATMs'. You want to know when and how often your customers are accessing these devices in comparison to using an in-branch machine. Power BI can collect data from both the IoT 'smart ATM' and your customers' mobile location or transaction history to visualize trends in their usage.

Power BI provides rich functionality like making correlations between different data sources.

Power BI, a cloud BI, and the analytic tool provide a brief summary of your critical data and connect to your every data source. It makes simple data evaluation, sharing scalable dashboards, embedded visuals, interactive reports and more. Power BI comes at a lower price point than Tableau, but scaled features and additional users will increase that price.

Tableau is built for data analysts, while Power BI is better suited to a general audience that ne Power BI uses the existing Microsoft systems like Azure, SQL, and Excel to build data visualizations that don't break the bank. This is a great choice for those who already work within the Microsoft products like Azure, Office 365, and Excel. eds business intelligence to enhance their analytics.[18]".Hence power bi can be used for visualization.

Motivation for Research:

The circumstances of pandemic COVID-19 led to study the current MOOC structure and need for a flexible open course module structure. The Literature study motivates further study into the problem definition.

Results:

The proposed open course module structure can be used for an interactive traditional holistic or partial flipped class model. The model suggests to incorporate only videos up to 20 minutes. Practical Programming lab sessions can be done by using open source compilers to do programming labs. Open-source web conferencing tool Jitsy can be used for web conferences. All open source tools for the learning management system are executable from one USB memory. In this proposal I try to investigate the number of enrolments in each course in a MOOC and find which course is most wanted according to that an open course module structure can be created. Web content and web usage mining can be used for data mining from several MOOC sites. The framework can be done by introducing IOT intelligent sensors for more decision making and power bi for visualization. The power of Artificial intelligence can be incorporated in the future research.

Conclusion :

The survey of various issues, challenges and techniques used in Social Network Mining for E-Learning evaluation strategy or Flipped Classroom Pedagogy based on previous and ongoing research, gave lot of information on current trend of research in this field and techniques and technologies and applications available to facilitate teaching cum learning aiding traditional, partial, or holistic flipped classroom pedagogy. Some of the findings are included for study and available packages and applications can be utilized for studying the system. It is concluded that research on the topic "**A comparative study of social network mining of massive open online courses to create an open course module structure"** will give a more flexible open course module structure by incorporating IoT which in turn facilitate the teaching community which is the target in terms of social commitment.

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