

Microlearning in Designing Data Mining Learning Course Material for Industrial Engineering Students

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Abstract

Data mining is one of the core courses offered by the Industrial Engineering study program at the State University of Malang and the process applied at the State University of Malang is theoretical and practicum. The implementation of knowledge transfer can be done online or offline. Synchronous and asynchronous are the implementation of learning that is carried out online. The difference between the two lies in the implementation time. Synchronous classes will be conducted simultaneously even though it is hindered by the distance between students who are not in the same place. Asynchronous courses will hold classes at different times according to the students' available time to access the material. The traditional or offline method is the implementation of face-to-face classes requiring the teachers and students to be at the same time and place and the teacher acts as a learning center. There are different learning methods that can be used to support knowledge transfer. Microlearning is a learning method that utilizes technological developments. The learning method offered is to use various interactive and communicative media to deliver the material. The media used are podcasts, presentation slides, infographics, e-modules, and videos that contain core discussions of the material.

Keywords: data mining; synchronous; asynchronous; offline; microlearning

Abstrak

Data mining merupakan salah satu mata kuliah inti yang ditawarkan oleh program studi Teknik Industri Universitas Negeri Malang dan proses yang diterapkan di Universitas Negeri Malang adalah teori dan praktikum. Pelaksanaan transfer knowledge dapat dilakukan secara online maupun offline. Sinkron dan asinkron adalah pelaksanaan pembelajaran yang dilakukan secara daring. Perbedaan keduanya terletak pada waktu pelaksanaannya. Kelas sinkron akan dilakukan secara bersamaan meskipun terhalang oleh jarak antara siswa yang tidak berada di tempat yang sama. Kursus asinkron akan mengadakan kelas pada waktu yang berbeda sesuai dengan waktu yang tersedia siswa untuk mengakses materi. Metode tradisional atau luring adalah pelaksanaan kelas tatap muka yang mensyaratkan guru dan siswa berada pada waktu dan tempat yang sama serta guru berperan sebagai pusat pembelajaran. Ada berbagai metode pembelajaran yang dapat digunakan untuk mendukung transfer pengetahuan. Microlearning merupakan salah satu metode pembelajaran yang memanfaatkan perkembangan teknologi. Metode pembelajaran yang ditawarkan adalah dengan menggunakan berbagai media interaktif dan komunikatif untuk menyampaikan materi. Media yang digunakan adalah podcast, slide presentasi, infografis, e-modul, dan video yang berisi inti pembahasan materi.

Kata kunci: penambangan data; sinkronis; asinkron; luring; microlearning

1. Pendahuluan

In the 21st century, humanity is facing a new phase with integrated and fast-moving information. To learn and extract all the information, we need to process all the data related to that information. One of the methods to process data is by using data mining. Data mining is a process of extraction of useful information and patterns from huge data [1]. After the information and patterns are found, they can be used to make decisions and development. Making data mining important for the operation of the business and certain organizations.

At State University of Malang offered a data mining course for Industrial Engineering study program. The implementation of learning data mining courses is carried out with an approach to deliver both theory and practice to use the Python language. The application of data mining required a lot of skill to be used effectively regarding the desired target, making it one of the most demanded skills in company recruitment. According to [2], the data scientist profession has a 36% job outlook for the next ten years, much faster than the average for all occupations. But with this huge opportunity, some conditions must be met. To be able to do data mining, one typically needs at least a skill and understanding of mathematics, statistics, computer science, or a related field. Making this field has great opportunities but with high difficulties.

To fulfill the high-skill data mining job demands, the educational system must improve the way of teaching so that students meet the required criteria. Unlike common courses, traditional learning on data mining will not work effectively, because it will prevent leading students toward innovation and creativity to learn new things [3]. The way traditional learning in classes will not meet the required time to master data mining since this field requires a lot of practice. Furthermore, traditional learning makes the knowledge that students are gaining easily forgotten [4].

Microlearning is the answer to a long and difficult journey to master data mining. Microlearning refers to a learning strategy designed using a series of short learning content and short activities that makes a mini course [5]. Microlearning works by dividing the vast knowledge of the field into smaller and more understandable fractions. Microlearning is suitable for the limit of the human brain for its attention span and cognitive overload. Microlearning grants students to access the course wherever, whenever, and in whatever format they want. Giving them a flexible pace they desired to learn as much as they like.

To implement microlearning in the field of data mining, the most important thing is to divide the topics into smaller units. Then these smaller units will be made into interactive or multimedia content, to create engaging learning units [6]. Creating content for small units needs a lot of time and preparation, so both the units and content are suitable for the students. Choosing the right content also needs to be considered in the unstable condition after the pandemic, with the offline and online class systems. The develop content-based microlearning in the form of presentation slides, handouts, podcasts, infographics, assessment tools (multiple choice questions, essays, and programming practices), as well as e-books that are used in learning data mining courses. The availability of microlearning based on SIPEJAR (a learning management system used in the State University of Malang) content for data mining courses is expected to be able to maximize the data analytics skills of Industrial Engineering students at the State University of Malang.

This study will discuss the implementation of microlearning in the data mining course to improve the learning effectiveness of students. Also discussing the advantages and disadvantages of each kind of content media, while implemented in different class systems.

1.1. Literature Review

Currently, technology is growing and is affecting the education system, especially the data mining course that uses databases to construct a model. There are many ways to learn data mining in this era, like a micro-learning system. Microlearning is a new teaching method that is related to e-learning. Nowadays, many people use the internet to get the latest information as

long as their devices are compatible. Microlearning allows students to learn whenever, wherever, and through whatever medium they want. There are already many types of media used in microlearning, such as presentation slides, videos, infographics, podcasts, and e-modules. These media can be used during synchronous or asynchronous events.

Data mining can gain information after collecting, cleaning, processing, and analyzing. Real data that is spread on the internet can not be immediately suitable for processing because the condition of the data is unstructured. As a result, some pre-processing is required, such as cleaning data and performing any necessary transformations, to gain some information to aid decision-making. Because of the development of technology, there are many ways to hold a class in data mining. These include online and offline learning. For online learning, there are synchronous and asynchronous, so there are three ways to hold a class.

Synchronous learning is an environment where the course is held with the teacher and student meeting on an online platform for teaching and discussion about a lesson [7]. Synchronous learning includes real time; therefore, no matter the geographical distance, a teacher can still get students via an online platform. Students may experience difficulties because of new environments that force them to interact with others; however, with synchronous learning, students can feel more at ease in each environment. A synchronous online platform makes all the students attention focus on the teacher, and the real-time concept can support students interactions with others using features like chat. Besides that, with synchronous learning, the lesson can be recorded and added to an e-library [8]. This achievement can help students master the materials by playing them many times. Synchronous learning can encourage motivation to stay engaged in activities with the teacher and students. And students problems about their studies can be instantly solved with the fast feedback that they can get and help to avoid miscommunication. Time availability and high bandwidth internet are two challenges that synchronous learning will face. Participants of synchronous learning can feel frustrated due to technical problems and cannot join class peacefully.

Based on [9], asynchronous learning is a learning method that does not happen in real-time. Asynchronous means set at a different time with a time lag among the participants [10]. Participants can join the meeting from other locations and interact in "non-real-time" communication. Asynchronous learning will enable teachers and students to interact for a longer time and provide with some facilities to support student study and reflection on the topics of discussion whenever and wherever. There is also a negative impact for some students because they may not get instant feedback or explanation about the things that they do not understand, and participants may tend to have irregular participation. The worst case possible is that some students that are not well disciplined may tend to copy and paste some assignments from the internet, which leads to plagiarism [9].

The traditional method of learning is face-to-face attendance, which is the most straightforward way in which humans can learn. Discussion in class is one of the ways to obtain and understand the materials. In the face-to-face method, the center of process learning is the teacher, and students are just recipients, but this concept can change depending on the situation. If students and teachers switch roles, students will be able to contribute more in class and become the main focus. So, the teacher can create activities that include discussions and problem-solving tasks within the group [11]. Therefore, this approach ensures students' interaction during the learning process. During offline learning, the assignments are provided

to help students gain knowledge, engage in intellectual development, share their opinions, and make them competent to complete them.

Besides that, in educational contexts, there is microlearning that can support learning sessions by giving some content and information in a short time, matching with participants' interest in e-learning to access all the information in and outside of class [12]. Microlearning has been implemented and researched in various fields such as healthcare, management, education, business, and others. Based on [13], already made a list of e-learning that delivers high-impact and immersive learning experiences, and microlearning is one of the top e-learning trends in 2020. Research has shown that microlearning can increase the variety of learning models [14] and help students adapt to an online environment. The online learning environment forces teachers to deal with various challenges, and to complete this, the design of the online environment must include solutions to help the students become independent learners. To accomplish this goal, the planning of the online environment should include tools that enable students to have ongoing communication with teachers. Microlearning allows teachers to be producers of content for students with various media such as presentation slides, videos, podcasts, e-module, and infographics. From the various media that are implied in microlearning, there are some advantages, like microlearning is performed in a short time burst, requires little effort from individual sessions, involves simple topics, helps users to keep updated, and is interactive.

2. Metode

Development SIPEJAR contents based-on microlearning for data mining courses is carried out using the ADDIE approach because this method is straightforward to understand the structure of the process sequence and can provide results according to the product desired by the user and does not require a long time to processing. To implement microlearning in the course, in this context are data mining course, there are five steps of ADDIE. This may be different from others depending on what is needed. This process can be explained as shown in Figure 1.

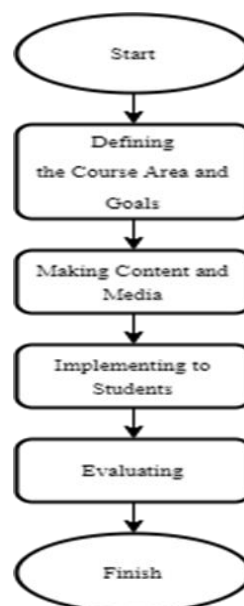


Figure 1. Flowchart for microlearning implementation.

Defining the Course Area and Goals. The boundaries area of the learning and the goals of the course must be set clear. The reason for doing this is to make sure that the next step, dividing topics, is easier to do. Topics that are out of the area will be the opposite reason for using microlearning, to reduce the workload of the human brain. Course goals guide dividing and rearranging the units to be linear and in context.

Design: Dividing into Smaller Units. Determine key point related to microlearning that is built related to the needs of students and lecturers in data mining course. Inside the course, there are several topics, some may be quite large. Based on the original goals of microlearning, these topics must be divided into smaller units. Making it easier for students to learn and break, setting their own pace. Smaller units allow students to find specific topics easier, rather than searching traditionally.

Inside these units, the content must not be large but not that small, just optimum for the average human attention span. Many studies have proved that the average adult has a maximum attention span of about 20 minutes, and in some cases, even less [15]. The attention span of learning begins to decay significantly after 20 minutes of intensive study. So, 20 minutes is the optimum time for how long the learning session on each unit. After each learning session, it is recommended to take a small break of fewer than 5 minutes. Then continue the cycle of learning sessions and small breaks again. After reaching 4 cycles, then it is time for a big break for at least 30 minutes to stretch the body and relax the eyes.

Development: Making Content and Media. Since each microlearning unit serves a specific objective, the forms it can take are diverse and depend on the intended outcome. An example of good learning media is it can be accessed across multiple devices at any time they want. The media can be a short chunk of text, infographics, short videos, short podcasts, virtual and augmented reality, quizzes, and more depending on what is best for the units to implement SIPEJAR contents development for learning data mining courses that have been designed previously. Of course, the more creative and engaging the content is the better it is to attract students' attention.

Implementation: To Students. At this step, all the units are packaged into one to be uploaded to the relevant platforms. It is recommended to upload the package to a flexible platform that can be accessed on multiple devices. Before the teacher begins the learning, it is important to make sure the content is displayed and works properly.

Evaluating: Feedback and Comments. At the end of the course, the student should be asked for feedback and comments about their experiences while they did the microlearning. The evaluation format can be formative and summative. The teacher should be able to evaluate the content, design, and process based on that. The evaluation also tells whether the goals of the course are achieved or not.

3. Hasil dan Pembahasan

Data mining is one of the core courses offered by the Industrial Engineering study program at the State University of Malang which distinguishes the UM Industrial Engineering bachelor program from other similar study programs. This course is able to meet the industry's need for the ability to analyze large amounts of data along with the development of information technology and artificial intelligence. The implementation of learning data mining courses is carried out with an approach to deliver both theory and practice to use the Python language to

solve the case problem during the lesson. The topics to be discussed are AI development methodology using data, tools project data mining, business understanding, data collection, data understanding, visualization data, data preparation, constructing data, model development, and evaluating model performance.

The media used for microlearning, such as podcasts, presentation slides, videos, infographics, and e-modules. A podcast is a digital audio file that is created and shared with others via an online platform [16]. Using podcasts for learning media can improve several aspects of education. Podcasts can be an innovative idea for teachers to design new classroom activities. Students can use this medium both inside and outside the classroom, and podcasts are a digital learning tool with practical value in classroom environments [17]. But there is some opinion that using podcasts as a learning medium can be misused. Teachers may use podcasts to replace lectures and established curriculum. Based on [17], students would start to neglect class materials and only rely solely on podcasts, and this would have minimal impact on learning gains and performance. Changes and technological advancements make a difference to the module. There is an electronic module (e-Module) which is an upgrade of the print module in digital form which adopts from the print module.

The benefit of e-Module is that it is interactive; there is some audio, video, image, and formative testing that can give instant feedback [18]. Added to that, the advantage of using e-Module is that students can interact for multiple purposes, where the use of e-Module utilizes media and makes students interested. The information related to the materials used for education can be transferred to alternative methods of presentation. Visuals are one of the most significant aspects of presenting information [19]. Graphics are one type of visualization that can quickly transfer information. Nowadays, the learning approach is in a more effective form by using classical graphs. Graphs that represent information are called infographics within a certain scope of using various visuals and texts in a visual form. The advantages of infographics are that they describe information in a structured way, are flexible, and can be prepared in alternative forms. But with the presentation of information that only uses visualization, makes the delivery of information less detailed. The development of technology and the popularity of computer-based learning and video tutorials in particular have likewise influenced the way of transferring knowledge [20]. Video tutorials can help students learn self-organized or self-regulated learning. The videos should therefore be a recorded demonstration showing how to operate or solve some tasks, and in combination with spoken instructions, direct students to follow the steps carried out. presentations using presentation slides are a common way of delivering materials. Using presentation slides will help in finding important points and understanding the materials. A combination of presentation slides and visual components can attract the attention of students during class.

There is a key point to consider for each media of microlearning. To make the podcast more interactive and communicative to the listener, the setting up of the podcast must be unique and use easy terminology so the listener can easily understand what was discussed. For interactive presentations, there are some tools that can be used and the common one is Google Slides. Presentation slides developed in this study explain all the topics that are covered in data mining course material starting from methodology to developing AI based on data analytics to evaluating model performance. Making videos for microlearning should discuss one topic per video, use a script to ensure that the video can stay concise and stay on topic, use animations to visually present ideas, record the videos with a natural-sounding tone, design the videos with

small screen due to learners prefer to use their phone. The topics covered in the videos are tools installation, data understanding, data visualization, data preparation, and developing a model. Besides that, another visual medium can be used in infographics. Infographics are visual media that combine visuals and text. This media involves facts, graphics, and trends. Infographics can be a reference for reading an overview of a topic. The data mining topics used in infographics are K-means Clustering, Decision Tree Model, Artificial Neural Network, and Association Rule (Market Basket Analysis). Each infographic explains the definition, elements, pros and cons, implementation, and the way to evaluate the performance of the algorithms. Due to the learning process can be held synchronous, asynchronous, and offline there is an e-module that can be used during those learning processes because an e-module is compatible with all browsers.

All those media can be uploaded to the relevant platform. So, the learners can study wherever, whenever, and choose the media that require them depending on their devices. All the media can be used in the learning process because this media can support teachers in delivering the materials and can help students to master the materials. In the end, there is also an evaluation of the microlearning that was implemented for the data mining course at the State University of Malang. This evaluation is to improve the content and practice of microlearning.

4. Simpulan

The development of technology makes the education fields need to adjust to these developments. There are some adjustments made, especially on the data mining course at the State University of Malang. The data mining course was implemented theoretically and in practicum for the learning process. The data mining classes are carried out synchronously, asynchronously, and offline. Synchronous and asynchronous classes are held online, and offline classes are face-to-face methods or traditional methods. To support this learning process there is a method that can be used. Microlearning is a method that takes advantage of the development of technology. The availability of microlearning based on SIPEJAR contents for data mining courses is expected to be able to maximize the data analytic skills of Industrial Engineering students at the State University of Malang. Students can access those media whenever, wherever, and choose the media their required. Using microlearning to support the learning process can attract students' attention. Due to the trends of e-learning so microlearning is the perfect way to help students with their studies. With microlearning, students can get various media, such as podcasts, presentation slides, infographics, e-module, and videos. However, the disadvantage is students become more dependent on all media online and there is no social interaction between each student in the class. Finally, this paper is expected to provide knowledge for teachers who want to implement microlearning in their learning process.

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