

# Implementation of Business Intelligence Dashboard with Data Mining Clustering for Student Academic Achievement

Mahfudin<sup>1</sup>, Setia Wirawan<sup>2</sup>

<sup>1,2</sup>Gunadarma University, Post Graduate Program on Information System, Margonda Raya 100, Depok 16424, Indonesia

**Abstract:** *Higher education in Indonesia continues to grow in every year. This can be seen from the results of the Higher Educational Statistical Year Book 2018 by the Ministry of Research and Technology of Indonesia which states there is 3,189 (2013), 3,280 (2014), 3,246 (2015), 3,275 (2016), 3,276 (2017), and 3,293 (2018). So that every university is required to always improve their quality in order to compete, one of the indicators is student achievement. This study aims to develop a business intelligence (BI) dashboard to help management in making decisions on student academic achievement. System Development Life Cycle is used as system development method and Five Layer BI used as its architecture. The Nine Step's Design method is used in data warehouse design. In data processing, data mining clustering with K-Means algorithm is used. Result of this research is a dashboard that display the distribution, ranking and grouping of students' grades based on instructor, course, and subject. Based on the information displayed it can be concluded that a class with a low number of students will be more optimal for student GPA. The policy that can be taken by management is to increase the number of classes and reduce the number of students in each class.*

**Keywords:** business intelligence, university, student academic achievement, clustering

## 1. Introduction

University has an important role to produce competitive human resources. University has duty to provide workers who have the abilities and competencies needed by the market. In addition, good universities will also be able to produce leaders and thinkers of a nation that determine the development of their country in the future [1].

The Ministry of Research, Technology and Higher Education of Indonesia published the Higher Education Statistics Year Book 2018 which stated the number of universities in Indonesia were 3,189 (2013), 3,280 (2014), 3,246 (2015), 3,275 (2016), 3,276 (2017), and 3,293 (2018) [2]. Based on these data it can be seen that the number of universities tends to increase. This thing certainly has a good impact on the country because the scope of education area will be wider, but not entirely for the university because the increasing number of other universities will also increase competition. Thus every university is required to always improve their quality in order to compete.

In an effort to improve the quality of university, students are one of the important aspects in evaluating the success of implementation of study programs at a university. Monitoring of incoming student, increasing student ability, student achievement, graduation ratio to total number of students, and graduate competencies should receive serious attention to gain stakeholder confidence in assessing and determining the use of graduates [3].

As time goes on the operational activities and development of the university will also increase the volume of data held. The increasing of data volume if processed optimally can have a positive impact on the university, such as facilitating the strategic decision-making process. However, if it is not

processed properly, this will only increase to the cost of storing data.

In the process of using data to support decision making, good analytical skill is needed. Because the relationship between variables in data generally cannot be seen directly, so it is necessary to process data before it becomes information. This information can be used as knowledge by decision makers. But in practice, the information that has been generated from the processing cannot be fully understood easily, so it takes a form of visualization to make information easily understood by decision makers, such as in the form of charts and tables.

With the development of information technology, difficulty of data processing can be reduced by using Business Intelligence. Business Intelligence is a series of applications and technologies for collecting, storing, analyzing, and presenting data access to facilitate company management in decision making [4]. Therefore, data processing becomes a central point in this research because this can be one way to improving the quality of a university.

## 2. Literature Review

### 2.1 Similar Researches

Study the literature by studying previous research related to business intelligence on student academic achievement. Related researches are explained as follows.

1. Analysis of business intelligence in managing alumni data in an effort to support the monitoring of alumni quality in university with a case study in the computer science faculty at Sriwijaya University. This research explained that business intelligence is used to process alumni data that

produces the number of participants for each graduation period, GPA trends, and study periods so that management can make decisions in improving the quality of alumni [5].

2. Analysis of the results of student studies through the implementation of business intelligence with OLAP method. This research explained that business intelligence was used to analyze correlation between the results of the bachelor students' learning process at STMIK AMIKOM Yogyakarta and the selection process for student admissions. Based on this analysis the decision maker can determine the optimal type of entrance test and standard of new student admissions [6].

3. Implementation of business intelligence in the dashboard application for monitoring student and graduate performance based on the third standard of BAN-PT for bachelor study program using SCRUM method. This study explains that business intelligence in the form of dashboard monitoring for reporting based on Key Performance Indicators from BAN-PT and forecasting on study programs using data from students and graduates of Information Systems at Telkom University [7].

4. Implementation of data mining to improving the quality of learning at higher education using K-Means clustering method (case study in TKJ study program at South Solok academy). This research clustered the GPA, distance traveled, number of attendances, and income of students' parents to classify the quality of student learning [8].

### 3. Methodology

The system development method used in this research is System Development Life Cycle (SDLC). This method consists of several stages, namely planning, analysis, design, implementation and testing.

#### 3.1 Planning

This stage is done by literature study and determine the object of research. Literature study aims to get the basic concepts that support research. Literature study is done by studying previous researches related to business intelligence and studying the theories that will be used in this research.

The determination of research objective is based on a literature study. The object of this research is to apply business intelligence to transaction data in the field of education. The data used are secondary data, that is "University of Wisconsin (UW) Madison Courses and Classes 2006-2017" obtained from the Kaggle website [9].

#### 3.2 Analysis

This stage is carried out an analysis for the requirements in the development of higher education business intelligence applications. Analysis consists of architectural and functional requirements analysis.

#### 3.2.1 Architectural Analysis

Based on the problems that have been identified in this research, namely the limitations of data processing in the grade distribution at university and lack of visualization of the processing result used for the decision-making process by management. Then the implementation of business intelligence is expected to be used to solve the problem. The business intelligence architecture has 4 main stages, namely Data Sources, Data Integration, Data Warehouse, and Business Intelligence.

#### 3.2.2 Functional Requirements Analysis

Functional requirements analysis is functions identification that have to be contained in university business intelligence application. These functions are as follows.

- 1) Web-based application so that it can be easily accessed by management.
- 2) The application can provide authentication features so that the information presented by the system is protected.
- 3) The application can process the data into information without changing the data source.
- 4) The application can present information in the form of text, tables & graphics making it easier for management to interpret it.

### 3.3 Design

#### 3.3.1 Business Intelligence Architecture Design

The business intelligence architecture stage has 4 stages, namely data sources, data integration, data warehouse, and business intelligence.

##### a) Data Source

Data Source is various data from internal and external university transactions that are used as data source when making business intelligence applications. In this research the data source used is "UW Madison Courses and Grades" obtained from the Kaggle website. Data time span starts from 2006 to 2017. This dataset consists of 10 files, namely course\_offerings, courses, grade\_distributions, instructors, rooms, schedules, sections, subject\_memberships, subjects, and teachings.

##### b) Data Integration

Data Integration is a variety of processes carried out to prepare and process data sources. Data integration stage in this study used extract, transform and load (ETL) process. As the name implies, ETL process consists of 3 stages, namely extract, transform, and load. Extract is retrieval of data contained in data sources. Transform is a change in data structure according to the information requirement to be presented by the application. Load is data storing that has been processed and is ready to be used as a data warehouse.

##### c) Data Warehouse

Data Warehouse is the storage of processed data from data integration stage. Data in the data warehouse will be processed to be used as an information base that will be presented to management. The data warehouse design process includes dimensional modeling, physical design, and development.

**d) Dimensional Modelling**

At this stage the data warehouse design uses the Nine Step Design method. The steps are as follows.

- **Choose the Process**  
Based on the background described earlier, the process of distributing student grades is the chosen process. This process is carried out when a class has over and student grades will be calculated.
- **Choose the Grain**  
Based on the process that has been determined, then the grain formed is assessment data. The analysis that can be done on the assessment data collection process includes GPA score, the number of students.
- **Identify and Conform the Dimensions**  
After the grain is selected, the dimensions and grain are adjusted in the form of a matrix, which is shown in table 1.

**Table 1: Dimension and grain adjustment matrix**

Grain \ Dimension	Course	Subject	Instructor	Section
GPA score	x	x	x	x
Number of students	x	x	x	x

1) Choose the Facts

Based on the grain that has been determined and the identification and adjustment of dimensions that have been conducted in the previous stage, the fact value is formed.

2) Store Pre-calculation in the Fact Table

The initial calculation of the data in the Grade fact table is as follows:

- The number of GPA scores is the average result of the multiplication between a\_count, ab\_count with, b\_count, bc\_count, c\_count, d\_count, f\_count with each weight. The weights of each value are shown in table 2.
- The number of students is the sum of a\_count, ab\_count with, b\_count, bc\_count, c\_count, d\_count, and f\_count.

**Table 2: Weight of grade**

Grade	A	AB	B	BC	C	D	F
Weight	4.00	3.50	3.00	2.50	2.00	1.00	0

3) Round Out the Dimension Tables

Based on the selected grain and the identification and adjustment of dimensions then the dimension table is determined. Descriptions of the dimension tables are shown in table 3.

**Table 3: Dimension table**

Dimension	Description
Course	Report can be displayed based on the course
Subject	Report can be displayed based on the subject
Instructor	Report can be displayed based on the instructor
Section	Report can be displayed based on the section

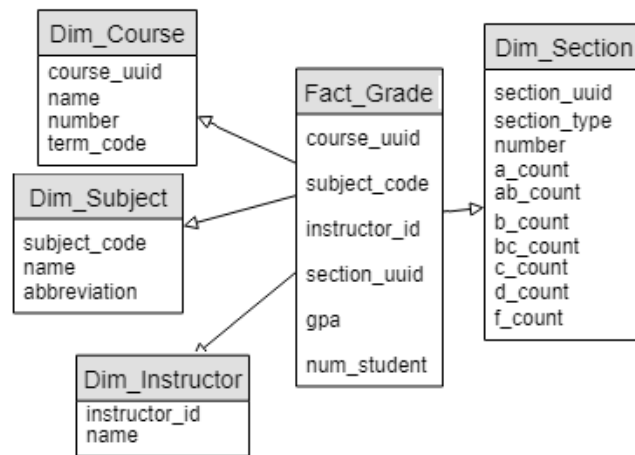
4) Choose the Durations of the Database

The duration of data to be stored in the data warehouse is 11 years and the data used is data at the end of the semester.

5) Determine the Need to Track Slowly Changing Dimension Changes to the data in the dimension tables are identified and used type 1, i.e. the dimension attributes that have changed are rewritten.

6) Decide the Physical Design

In the final stage, physical data warehouse design is carried out. The data warehouse design used is star schema. Figure 1 shows dimensional scheme of assessment process. This design consists of a fact and 4 dimensions. That fact is grade, while dimensions consist of course, subject, instructor, and section.



**Figure 1: Dimensional scheme of assessment process**

7) Physical Design

At physical design stage, the dimensional modeling design will be translated into the physical data structure. Physical data structure includes data in the data warehouse and metadata to display data source mappings with destinations. Table 4 is the physical data structure of this business intelligence.

**Table 4: Physical data structure**

Dimension	Description
Course	Report can be displayed based on course. The course dimension consists of name, number, and term_code, which course_uuid as the primary key.
Subject	Report can be displayed based on subject. The subject dimension consists of name and abbreviation, which subject_code as the primary key.
Instructor	Report can be displayed based on instructor. The instructor dimension consists of name, which instructor_id as the primary key.
Section	Report can be displayed based on section. The section dimension consists of section_type, number, a_count, ab_count, b_count, bc_count, c_count, d_count, and f_count, which section_uuid as the primary key.

Further explanation of the physical data structure is as follows.

- 1) Table 5 is the physical data structure and metadata of the Dim\_Course table. The course dimension table is in DW\_GRADE\_DIST database and has course\_uuid, name, number and term\_code fields. Data sources used in this dimension table are courses and course\_offerings

files.  
 2) Table 6 is the physical data structure and metadata of the Dim\_Subject table. The subject dimension table is in DW\_GRADE\_DIST database and has subject\_code, name, and abbreviation fields. Data source used in this dimension table is subjects file.

3) Table 7 is the physical data structure and metadata of the Dim\_Instructor table. The instructor dimension table is in DW\_GRADE\_DIST database and has instructor\_id and name fields. Data source used in this dimension table is instructors file.

**Table 5:** Physical data structure and metadata dari Dim\_Course table

Field	Type	Length	Description	Data Source (courses, course_offerings)			Transformation
				Field	Type	Length	
course_uuid	varchar	36	Primary key	uuid	varchar		
name	varchar	255		name	varchar		
number	integer			number	varchar		Cast
term_code	varchar	4		term_code	varchar		

**Table 6:** Physical data structure and metadata of Dim\_Subject table

Field	Type	Length	Description	Data Source (subjects)			Transformation
				Field	Type	Length	
subject_code	Varchar	5	Primary key	code	varchar		
name	varchar	255		name	varchar		
abbreviation	varchar	50		abbreviation	varchar		

**Table 7:** Physical data structure and metadata of Dim\_Instructor table

Field	Type	Length	Description	Data Source (instructors)			Transformation
				Field	Type	Length	
instructor_id	varchar	7	Primary key	id	varchar		
name	varchar	255		name	varchar		

**Table 8:** Physical data structure and metadata of Dim\_Section table

Field	Type	Length	Description	Data Source (sections, grade_distributions)			Transformation
				Field	Type	Length	
section_uuid	varchar	36	Primary key	uuid	varchar		
section_type	varchar	3		section_type	varchar		
number	integer			number	varchar		Cast
a_count	integer			a_count	varchar		Cast
ab_count	integer			ab_count	varchar		Cast
b_count	integer			b_count	varchar		Cast
bc_count	integer			bc_count	varchar		Cast
c_count	integer			c_count	varchar		Cast
d_count	integer			d_count	varchar		Cast
f_count	integer			f_count	varchar		Cast

**Table 9:** Physical data structure and metadata of Fact\_Grade table

Field	Type	Length	Description	Data Source ()			Transformation
				Field	Type	Length	
course_uuid	varchar	36		course_uuid	varchar	36	
subject_code	varchar	5		subject_code	varchar		
instructor_id	varchar	7		instructor_id	varchar		
section_uuid	varchar	36		section_uuid	varchar	36	
gpa	float			$(4.0*a\_count + 3.5*ab\_count + 3.0*b\_count + 2.5*bc\_count + 2*c\_count + 1*d\_count) / (a\_count + ab\_count + b\_count + bc\_count + c\_count + d\_count + f\_count)$		float	
num_student	integer			$a\_count + ab\_count + b\_count + bc\_count + c\_count + d\_count + f\_count$		integer	

1) Table 8 is the physical data structure and metadata of the Dim\_Section table. The section dimension table is in DW\_GRADE\_DIST database and has section\_uuid, section\_type, number, a\_count, ab\_count, b\_count, bc\_count, c\_count, d\_count, and f\_count fields. Data source used in this dimension table are sections and grade\_distributions files.

2) Table 9 is the physical data structure and metadata of the Fact\_Grade table. The grade fact table is in DW\_GRADE\_DIST database and has course\_uuid, subject\_code, instructor\_id, section\_uuid, gpa, and num\_student fields. Data source used in this fact table are Dim\_Course, Dim\_Section tables in DW\_GRADE\_DIST database and subject\_memberships, sections, and

teachings files.

**(1) Design Development**

In the design development process, the implementation of physical data design using a tool is carried out. The tool used in this research is SQL Server Data Tools.

*Business Intelligence*

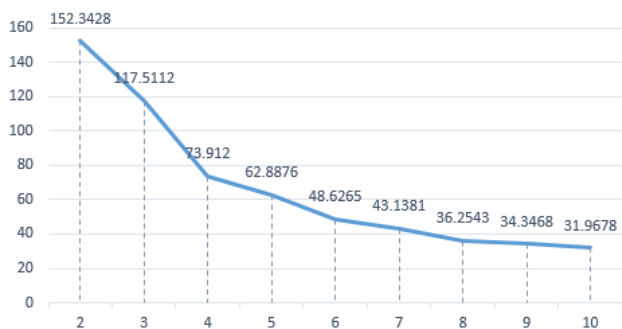
Business Intelligence is the stage of presenting information that has been processed in the data warehouse. In this research, information will be displayed based on instructor, course, and subject. A summary of all information will also be presented in this application.

**3.3.2 Clustering Design**

At this stage the clustering design of business intelligence is carried out by determining the algorithm to be used and preparing it. The algorithm used for the clustering process is K-Means. The initial stage of this algorithm is to determine the number of clusters formed as a result. The process of determining the optimal number of clusters in this research used the Elbow method. This method calculates the Sum of Square Error (SSE) value of each cluster. Experiments were carried out on the number of clusters between 2 to 10. The process was carried out on course, subject, and instructor.

*a) Cluster Determination for Course Data*

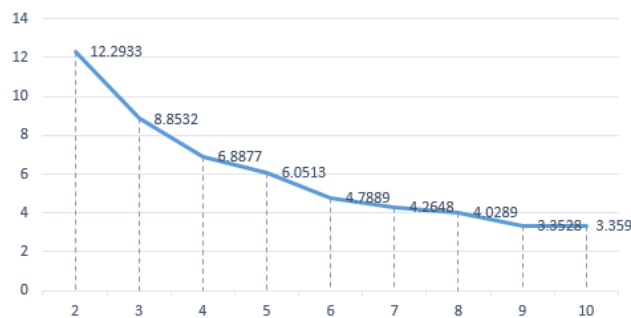
The experimental result to determine the optimal number of clustering for the course data is a graph of SSE changes shown in Figure 2. Based on the results of clustering experiments, it appears that the elbow is formed in cluster 4, so that this cluster will be used in the courses clustering process in business intelligence.



**Figure 2:** SSE value changes for courses clustering

*b) Cluster Determination for Subject Data*

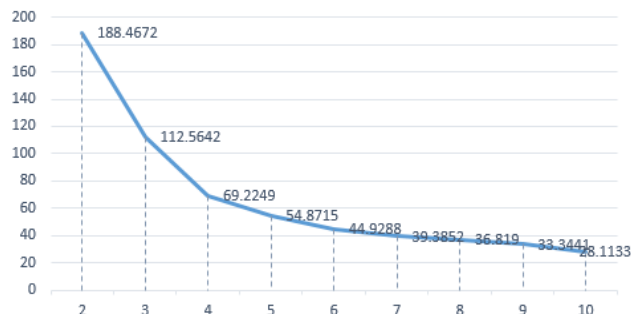
The experimental result to determine the optimal number of clustering for the subject data is a graph of SSE changes shown in Figure 3. Based on the results of clustering experiments, it appears that the elbow is formed in cluster 4, so that this cluster will be used in the courses clustering process in business intelligence.



**Figure 3:** SSE value changes for subjects clustering

*c) Cluster Determination for Instructor Data*

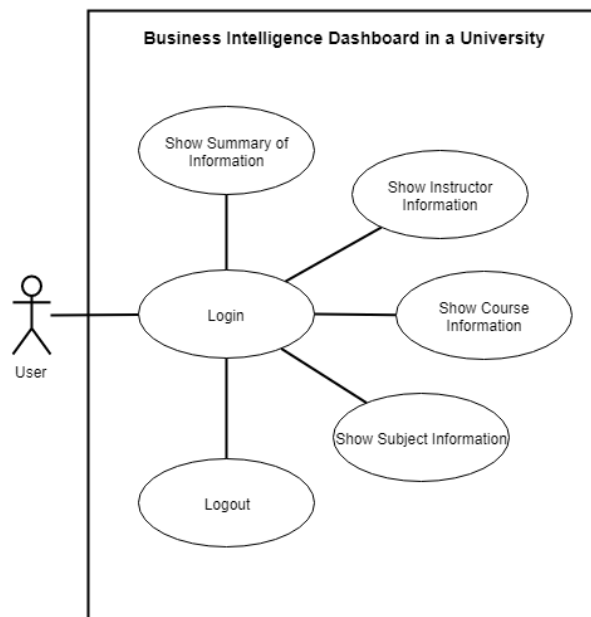
The experimental result to determine the optimal number of clustering for the instructor data is a graph of SSE changes shown in Figure 4. Based on the results of clustering experiments, it appears that the elbow is formed in cluster 4, so that this cluster will be used in the instructors clustering process in business intelligence.



**Figure 4:** SSE value changes for instructors clustering

**3.3.3 Application Modeling**

Application modeling is used to describe the application process flow. The modeling in this research uses one of the unified modeling language (UML), namely the use case diagram. Use case diagram is used to define the relationship between actors and activities that occur in the system. The use case diagram of business intelligence for student academic achievement is shown in Figure 5.



**Figure 5:** Use case diagram of business intelligence

Use case diagram of the business intelligence in this research has one actor, namely User. The user acts as the application user which will only be owned by management at the university. This actor can perform 6 activities, namely login, logout, show summary of information, show instructor information, show course information, and show subject.

### 3.4 Implementation

At this stage programming is done using PHP general-purpose server-side scripting language and SQL Server 2014 database management system to make the application that is in accordance with the design. The results of the implementation will be explained in the next section.

### 3.5 Testing

At this stage, testing is done using the Black box method on the application that has been made. The test results will be explained in the next section.

## 4. Result and Analysis

### 4.1 Implementation of Business Intelligence

The result of this research is an application in the form of dashboard that displays information about student grades. This application is divided into 4 main pages, namely summary, instructor, course, & subject.

#### 4.1.1 Summary Page

The summary page is a page that displays summary of information in business intelligence, this page is shown in Appendix Figure 6. This page consists of 3 pie charts, namely the GPA distribution based on instructor, class, and subject. Each diagram consists of 7 parameters, namely A is a range of scores between 3.51-4.00, AB is a range of scores between 3.01-3.50, B is a range of scores between 2.51-3.00, BC is a range of scores between 2.01-2.50, C is a range of scores between 1.01-2.00, D is a range of scores between 0.01-1.00, and F is 0.00. At the bottom of the diagram, there is a legend displays parameter information and can be used to set the active status of each parameter.

Based on the information displayed on this page, management can find out the distribution of student grades based on instructor, course, and subject. One decision that can be taken is to determine how much needs to be evaluated because it has an unsatisfactory achievement.

#### 4.1.2 Instructor Page

The Instructor page is a page that displays information on student grades from the instructor's side. This page consists of 3 parts, a bar diagram of instructor performance, scatter diagrams of clustering results, and a table for instructor performance details.

At the top of this page is a bar chart showing the comparison between GPA score and the average student per class owned by the instructor, this is shown in Appendix Figure 7. The x-

axis in the diagram shows instructor's name and the y-axis for the values of each parameter. The diagram has 2 parameters, namely GPA score and average student per class. Data in the diagram is sorted by GPA score parameter. Diagram navigation features available are zoom, move and reset. The zoom feature can be used by dragging the cursor over certain area. After the zoom feature is performed on the diagram, then the move and reset features will appear at the top right of the diagram, as shown in Appendix Figure 8.

The second part of this page is a scatter chart that displays the clustering result, this is shown in Appendix Figure 9. The x-axis in this diagram shows cluster name and the y-axis shows parameter value. This diagram has 3 parameters as consideration in clustering, namely GPA score, average student per class, number of students, and number of classes owned by the instructor. Clustering result displays for each parameter can be accessed through tab button at the top of diagram.

The last section on this page is a table that displays detailed instructor performance data, this is shown in Appendix Figure 10. This table has 7 columns, namely rank, instructor name, GPA score, average student/class, number of students, number of classes, and clustering result. The table has several features, such as determining the amount of data displayed per page, searching data in table, sorting and filtering in each column, and pagination.

Based on the information displayed on this page, management can find out student GPA score distribution based on instructor and it can be seen from bar chart that the higher GPA score then the average number of students per class will tend to be lower. So the information that can be taken is the student GPA score based on the instructor will be more optimal if the instructor has a small number of students in the class. Management policies that can be taken based on information that has been found is reducing the number of students in the class owned by instructor to improve student achievement.

Clustering results show cluster 0 has GPA score that is spread all over from 0.00 to 4.0, student/class is spread between 0 and 464, the number of students is quite low from 0 to 623, and the number of classes between 1 and 231. Cluster 1 has fairly good GPA score from 2.47 to 4.00, student/class is spread between 2.63 and 425, the number of students between 619 and 2202, and the number of classes from 2 to 392. Cluster 2 has fairly good GPA between 2.51 and 3.95, students/class is spread between 18.65 and 295.71, the number of students between 5958 and 23549, and large number of classes between 30 and 617. Cluster 3 has fairly good GPA between 2.55 and 4.00, students/class is spread between 11.77 and 583.00, the number of students is quite a lot between 2213 and 5719, and the number of classes between 7 and 372. So, it was concluded that the results of clustering were very influenced by the number of students. The results of clustering can be used by management to group instructors in executing policies.

Data in bar charts and scatter charts are displayed visually making it easy to analyze in general but will be difficult in

specific. Therefore, the instructor data table is presented so management can do more detailed analysis if needed.

#### 4.1.3 Course Page

The Course page is a page that displays information on student grades from the course's side. This page consists of 3 parts, a bar diagram of course performance, scatter diagrams of clustering results, and a table for course performance details. Information visualization on this page has same structure as instructor page. One part of course page is shown in Appendix Figure 11.

Based on the information displayed on this page, the management can find out of student grades distribution based on the course and similar to instructor data that the higher GPA score then the average numbers of student in class will tend to be lower. So, the information that can be taken is the student GPA score based on the course will be more optimal if it has a small number of students in the class. Management policy that can be taken based on information that has been found are increasing the number of classes in courses that still have unsatisfactory student performance and reducing the number of students in each class to improve student achievement.

#### 4.1.4 Subject Page

The subject page is a page that displays information on student grades from the subject's side. This page consists of 3 parts, a bar diagram of subject performance, scatter diagrams of clustering results, and a table for subject performance details. Information visualization on this page has same structure as instructor page. One part of subject page is shown in Appendix Figure 12.

Based on the information displayed on this page, the management can find out of student grades distribution based on the subject and similar to instructor data and course data that the higher GPA score then the average numbers of student in class will tend to be lower. So, the information that can be taken is the student GPA score based on the subject will be more optimal if it has a small number of students in the class. Management policy that can be taken based on information that has been found is to increase the number of classes of courses in subjects that still have unsatisfactory performance. Management can also make deeper observations on subjects that have satisfactory student performance in order to maximize student achievement on other subjects.

## 4.2 Testing of Business Intelligence

Application testing uses the Black Box method to test the Summary, Instructor, Course, and Subject modules for the functions and generated information. Based on testing that has been done on the application there are 35 test cases. Test results show that all test cases match the expected results. Thus, application development has been completed and worked as expected.

## 5. Conclusion

Business intelligence dashboard for student academic achievement has been developed successfully in the form of web-based application. Data processing in the application used a data warehouse and data mining clustering with K-Means algorithm. Application testing has been conducted using the black box method which shown that all application functions work as expected.

Information generated from UW Madison courses and grades data on business intelligence is the distribution of student GPA score based on instructor, course, and subject. This information has been presented in the informative form, such as pie chart, bar chart, scatter diagram, and table. Based on this information, it appears that class with a small number of students will be more optimal for student GPA score. So, the policy that can be taken by management is increasing the number of class and reducing the number of students in each class to increase student academic achievement.

## 6. Future Works

This research still requires further development in several aspects, such as data, analysis, testing. In the aspect of data, currently used is the property of the University of Wisconsin - Madison located in United State thus further development can be used data from university in Indonesia. The aspect of analysis in data clustering, currently used is K-Means algorithm thus further development can add other clustering algorithm so that it can be compared. In testing aspect, the application has not been tested with user acceptance test method thus further research can do the testing to determine suitability of information needs.

## References

- [1] Soni A. N., et al., "Peranan Perguruan Tinggi dalam Meningkatkan Kualitas Pendidikan di Indonesia untuk Menghadapi ASEAN Community 2015", Share: Social Work Jurnal, VI (2), pp. 154-272, 2016.
- [2] Pusdatin Kemenristekdikti, Statistik Pendidikan Tinggi 2018, Pusdatin Iptek Dikti, Jakarta, 2018.
- [3] Mujib R., et al., "Penerapan Data Mining untuk Evaluasi Kinerja Akademik Mahasiswa Menggunakan Algoritma Naive Bayes Classifier", Jurnal EECCIS, VII (1), pp. 59-64, 2013.
- [4] Imelda, "Business Intelligence", Majalah Ilmiah UNIKOM, XI (1), 2013.
- [5] Mgs. Afriyan F., et al., "Analisis Busines Intelligence pada Pengelolaan Data Alumni: Upaya Mendukung Monitoring Kualitas Alumni di Perguruan Tinggi (Studi Kasus di Fakultas Ilmu Komputer Universitas Sriwijaya)", Jurnal Generic, VIII (2), pp. 221-229, 2013.
- [6] Ike V., "Analisis Hasil Studi Mahasiswa Melalui Penerapan Business Intelligence dengan Teknik OLAP", Jurnal Ilmiah DASI, XVII (4), pp. 63-68, 2016.
- [7] Fanny F. N. F., et al., "Penerapan Business Intelligence pada Aplikasi Dashboard Monitoring Performansi Mahasiswa dan Lulusan Berdasarkan Standar 3 BAN-PT Program Studi Sarjana Menggunakan Metode

SCRUM”, Jurnal Rekayasa Sistem & Industri, I (1), pp. 144-151, 2014.

- [8] Koko H., “Penerapan Data Mining dalam Meningkatkan Mutu Pembelajaran Pada Instansi Perguruan Tinggi Menggunakan Metode K-Means Clustering (Studi Kasus di Program Studi TKJ Akademi Komunitas Solok Selatan)”, TEKNOSI, II (3), pp. 31-40, 2016.
- [9] Keenan Thompson, “UW Madison Courses and Grades 2006-2017”, kaggle.com, May 16, 2018. [Online]. Available: <https://www.kaggle.com/Madgrades/uw-madison-courses>. [Accessed: Sept. 26, 2019].

Author Profile



Mahfudin received the bachelor’s degree of computer science in Information System in 2017 and continued to study information system master in Business Information System, the author is also conducting research on decision support system, data mining, and system development.

Setia Wirawan received the doctor of computer science in Information System in 2007, the author is also conducting research on content base image retrieval, multimedia education, and semantic web.

Appendix

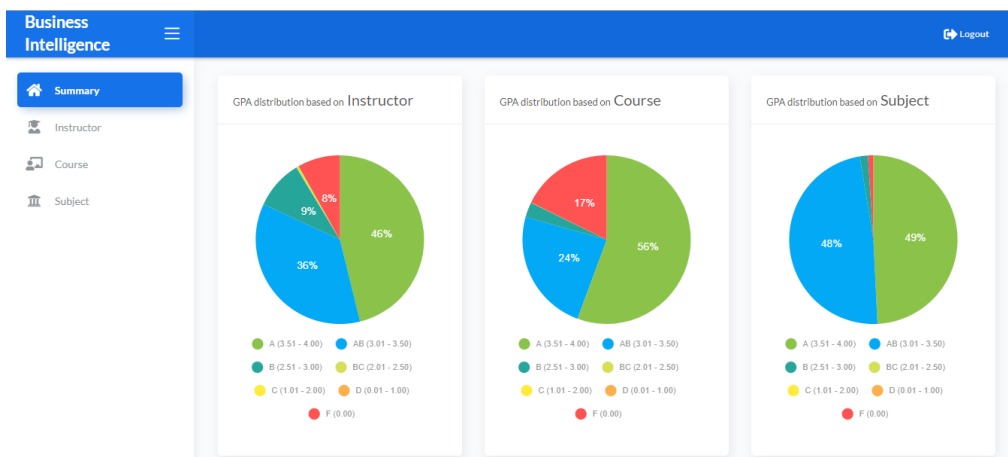


Figure 6: Summary page

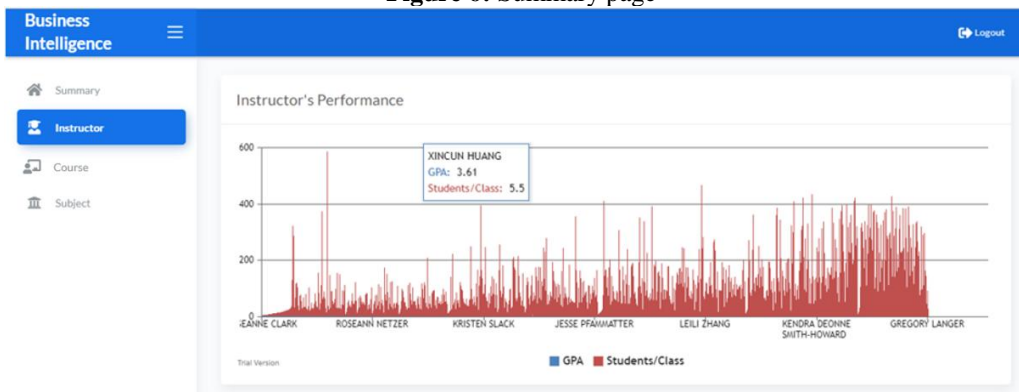


Figure 7: Bar chart on instructor page

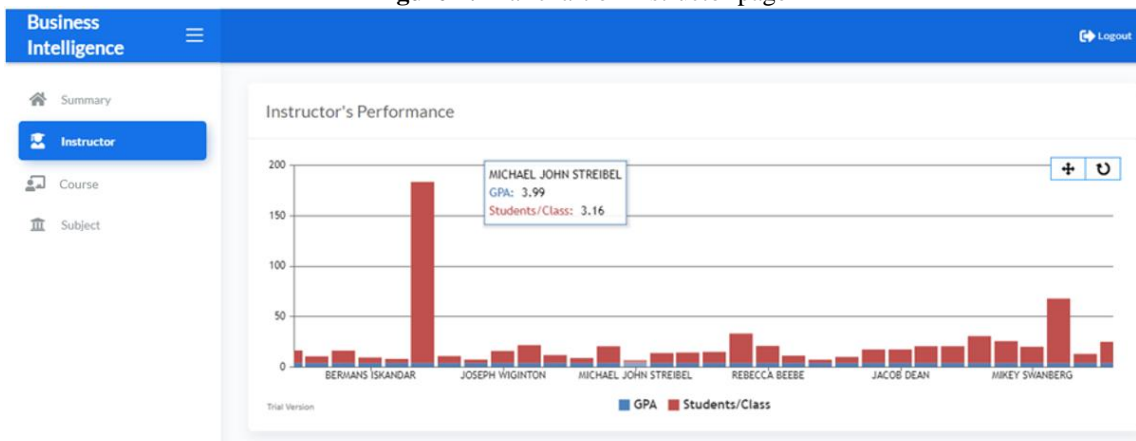


Figure 8: Zoomed bar chart on instructor page



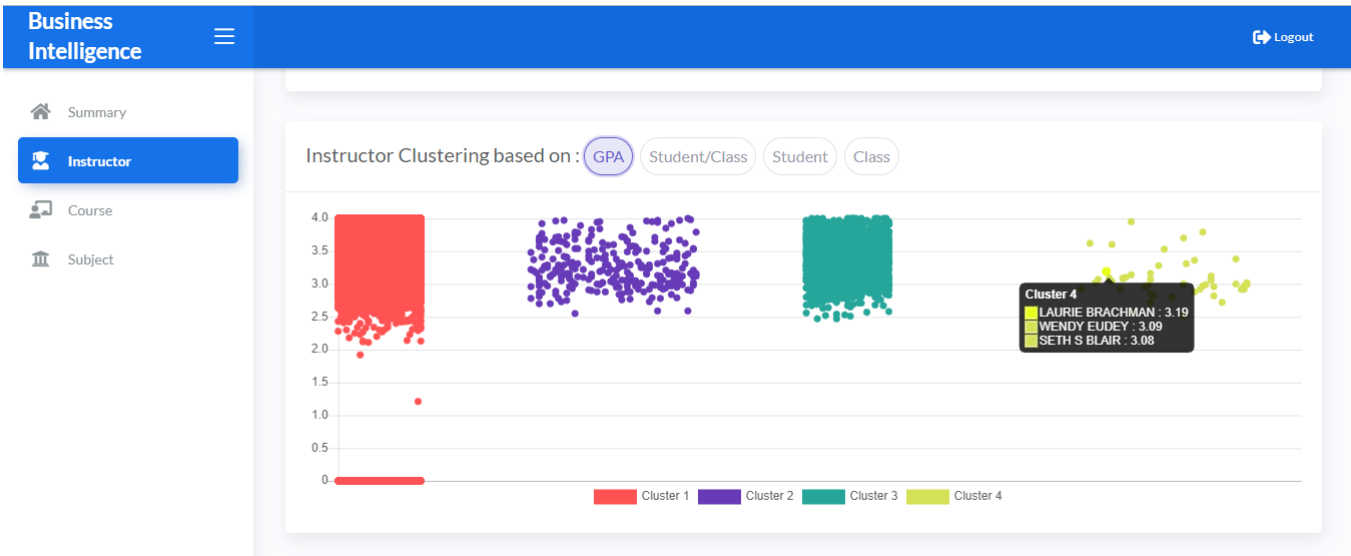


Figure 9: Scatter diagram on instructor page

#	Name	GPA	Student/Class	Student	Class	Cluster
1	ROSEANNE CLARK	4.00	0.05	2	38	0
2	PAUL WILLIAM KRANNER	4.00	0.09	4	43	0
3	SALLY CHISHOLM	4.00	0.14	18	130	0
4	DAVID FELDSTEIN	4.00	0.14	1	7	0
5	PAUL SONDEL	4.00	0.16	12	76	0
6	CELINA CHECURA	4.00	0.17	2	12	0
7	PAMELA KLING	4.00	0.18	6	34	0
8	MICHAEL STOKER	4.00	0.20	1	5	0
9	TERENCE BARRY	4.00	0.21	6	29	0
10	DAVID WARGOWSKI	4.00	0.25	9	36	0

Figure 10: Table on instructor page

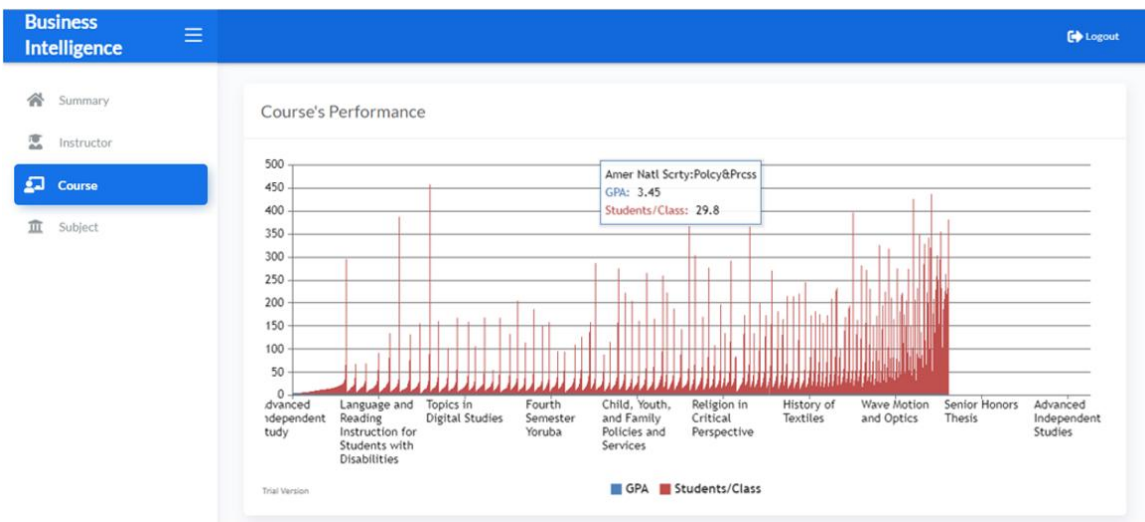


Figure 11: Bar chart on course page

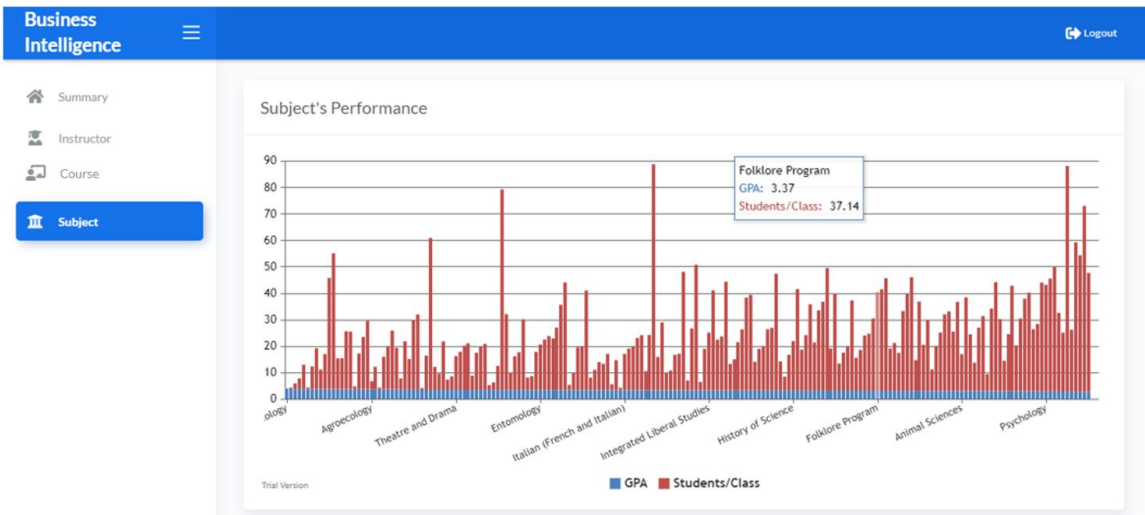


Figure 12: Bar chart on subject page