CLUSTER ANALYSIS OF STUDENTS' MULTIPLE INTELLIGENCES IN FIRST GRADE AT MADRASAH IBTIDAIYAH AL-INAYAH IN INDONESIA

Ismah[1,*], Rahmita Nurul Muthmainnah[2], Viarti Eminita[3], Anwar Ilmar Ramadhan[4]

[1,2,3]**Department of Mathematics Education, Faculty of Education,**
[4]**Department of Mechanical Engineering, Faculty of Engineering,**
[1234]**Universitas Muhammadiyah Jakarta, Indonesia**
[*]**Email: ismah.fr@gmail.com**

Abstract
Quality learning can be achieved when the teachers can carry out their duties appropriately according to the students' needs. Since the students' intelligence is diverse and complex, the teacher should determine the learning method that is in accordance with the students' intelligence. The purpose of this research is to classify the intelligence tendencies possessed by students based on Gardner's theory, namely: linguistic, logical mathematic, spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalistic intelligence. The subjects of the study were 42 students in 1st grade at Madrasah Ibtidaiyah Al-Inayah located at Pasar Rebo. Data is processed using data mining algorithms with clustering techniques and data processing using Weka software. The results of the analysis obtained by two clusters as many as 20 students (48%) had a tendency of 8 multiple intelligences slightly higher than the other 22 students (52%). The highest intelligence of 13.14% is shown in interpersonal intelligence in the second cluster and 13.05% in the first cluster, which means that students have communication skills that are built directly against the interlocutor (face to face). Another high intelligence is math logic intelligence, this supports the learning process of mathematics in the classroom.

Keywords: multiple intelligences, cluster analysis, data mining

INTRODUCTION
The rapid development of information and communication technology (ICT) is one of the challenges that must be faced by people in various parts of the world. It does not mean that ICT is a threat, but instead ICT is a trigger for people to be able to adjust their existence and be able to implement it in various aspects of life. The challenge requires qualified human resources, so it becomes the task for educational institutions to achieve learning goals and create a reliable generation of the nation.

Education is a medium for children to develop their potencial, so that educational programs need to be designed with the aim to help, to guide, to train, and to teach them to improve their potential or quality. In this case, teachers must be able to adjust the potential of every student in the learning process in order to develop their own potential (Dunn, 2000). Some experts said that the potential possessed by humans is in the form of Spiritual Quotient (SQ), Intelligent Quotient (IQ), Emotional Quotient (EQ), and Creativity Quotient (CQ). According to Behling (Behling, n.d.) cognitive abilities as well as intellectual intelligence, where these abilities include learning and solving problems, through symbols or verbally. Goleman (Goleman & Daniel, 2009) stated that approximately 20% of IQ was donated to achieve success, while the remaining 80% is another factor, which is among emotional intelligence. Whereas Berman (Berman & Evans, 2001) stated that the spiritual intelligence as a power that facilitated dialogue between emotions with mind, as well as soul with body.

According to Horward Gardner (Gardner, 1993) it is very important to recognize and maintain all the varied human intelligence, and all combinations of intelligence. We are all very different especially because we all have different combinations of intelligence. When that happened, then humans will be had better opportunities to solve many problems faced in the world. A child may have one intelligence that is dominant compared to other intelligences, or have some intelligences, this is called multiple intelligence (Suarca, Soetjiningsih, & Ardjana, 2016). If the education program only focuses on one intelligence, the other intelligences possessed by the child will not develop or even disappear because the environment does not provide the space. In human life, not everyone will become a teacher, or all become doctors, some will become farmers, artists, athletes, and others, and these differences will seem beautiful because often the problems that arise can be resolved with various fields of expertise or varying perspectives. In addition, human nature is essentially a social creature whom certainly need each other.

Research related to the development or application of learning methods and media has been widely carried out, with the aim being to improve students' learning outcomes and increase students' learning motivation and others. However, the development or application of learning methods and media are sometimes is not adjusted to the students' needs through early detection of the type of intelligence possessed by students. Basically, every child has intelligence with different levels and indicators (Baş & Beyhan, 2010), which human beings differ with the others (Emmiyati, Rasyid, Rahman, Arsyad, & Dirawan, 2014). That intelligence can be increased by providing suitable stimulus that is related to the type of the child's intelligence (Sulaiman, Abdurahman, & Rahim, 2010). If the detection of intelligence toward the child is done to determine the type of intelligence possessed, the teacher or researcher will not conduct the mistake in determining the methods or learning media to be developed or applied. The result is aimed to achieve the learning objectives and students can follow the learning process comfortably because it is related with indicator of intelligence possessed (Amir, 2013).

Grade 1 of Primary School Students are part of Early Childhood. Based on the National Association for Education of Young Children (NAEYC), Early Childhood are in the age range between 0-8 years (Aisyah, 2009), where grade 1 of Primary School students aged between 6 to 8 years. Early childhood is a period of growth and development of children in every aspect of adjusting the environment (Rozalena & Kristiawan, 2017). A period of growth and development is a time of easy stimulation from the environment. Therefore, early childhood period is the right time to be given a positive stimulus as a basis for the

maturation process. Therefore in this research, a case study was conducted in grade 1 at Madrasah Ibtidaiyah (MI) Al-Inayah Pasar Rebo, East Jakarta as an effort to detect multiple intelligences owned by students, so that learning media or learning methods are developed and implemented according to students' needs that related with their multiple intelligences.

Wechsler (Suryabrata, 2005), defines intelligence as the ability or skill of individuals to act in a structured manner, think rationally, and relate to the environment appropriately. The development of intelligence possessed by humans will take place quickly until the age of 15 years, in line with human growth and development, which then will progress slowly. Santrock (Santrock, 2007) states that intelligence possessed by individuals is shown in individual expertise in solving problems, being able to adapt to the environment and learning from the life experiences they have lived. The expertise they have is varied even among them which are unique. This expertise is influenced by several factors including the environment.

In Gardner's theory (Gardner, 2003) it is said that every human being born has intelligence, and the intelligence possessed is not singular but plural (multiple) which merges into a unity of expertise so that it can be used in solving problems, making problems and doing something useful in life. Multiple intelligence that humans have as capital in multiple intelligence theory by Gardner. There are 8 multiple intelligences possessed by humans, namely linguistic, logical mathematic, kinesthetic, spatial, musical, interpersonal, intrapersonal, and naturalistic intelligence. The characteristics of each intelligence can be seen in Table 1. The purpose of this research is to classify the intelligence tendencies possessed by students based on Gardner's theory, namely: linguistic, logical mathematic, spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalistic intelligence.

Table 1. Multiple Intelegences Development

Learner type	Likes to	Is good at	Learns best by
Verbal/Linguistic "The Word Player"	Read/write Use puns Tell stories	Memorizing names. Places, dates, trivia	Saying, hearing, and seeing words and stories
Logical/ Mathematical "The Questioner"	Conduct Experiments Figure things out Work with numbers Ask questions Explores patterns and relationships	Math Reasoning Logic Problem Solving Quantitative Analysis	Categorizing Classifiying Working with abstract patterns and relationships Quantifiying
Spatial "The Visualizer"	Draw, build, design, and create things Daydream Look at pictures/slides Watch movies Play with machines	Imagining things Sensing changes Mazes and puzzles Reading maps/charts Diagramming Charting	Visualizing Dreaming Using the mind's eye Working with colors/pictures Outlining
Musical "The Music Lover"	Sing. Hum Listen to music Play an instrument Respond to music	Picking up sounds Remembering melodies Noticing pitches and rhythms Keeping time	Rhythm Melody Music Sound Drumming Listening
Bodily / Kinesthetic "The Mover"	Move around Touch and talk Use body language Engage in activity Interact physically Experiment	Physical activies (sports / dancing / acting) Crafts Making things Mapping Body models of concepts	Touching Moving Interacting with spaces Proceeding knowledge through bodily positions
Interpersonal "The Socializer"	Have lots of friends Talk to people Join groups Interest Network Personalize	Understanding people Leading others Organizing Communication Manipulating Mediating conflicts	Sharing Comparing Relating Cooperating Interviewing Leading Interacting Listening
Intrapersonal "The Individual"	Work alone Pursue own interest Reflect Observe	Understanding self Focusing inward on feelings/dreams Following instincts Pursuing interests Being intuitive	Reflection Individualized projects Self-paced instruction Having own space Intuition
Naturalist "Nature Lover"	Observe/explore nature Read about nature Grow plants and garden	Outdoor recreation activities Learning taxonomies for plants/animals Understanding how	Collecting data through observation Drawing/photographing outdoor subjects Reading/writing

Learner type	Likes to	Is good at	Learns best by
			Performing

Adapted by Nuña del Salvador cited in (Cardenas, Camacho, Mariano, & Redondo, 2010)

RESEARCH METHOD

The subjects of the study were 42 students in 1st grade at Madrasah Ibtidaiyah Al-Inayah located at Pasar Rebo. Data were obtained using Questionnaire instruments given to the students to find out their multiple intelligences, with 5 answer scale : SA= strongly agree; A=agree; N=neutral; DA=disagree; and SD=strongly disagree. Each type of multiple intelligence is represented by 10 statements, so that the overall total is 80 statements, with a minimum score of each intelligence being 10 and a maximum of 50.

Data is processed using data mining algorithms, according to Turban (Turban, 2005) data mining is a process that uses statistical techniques, mathematics, artificial intelligence, machine learning to extract and identify useful information and related knowledge from various large databases. Data mining functions including prediction, description, classification, association. Classification can be done using clustering techniques. Clustering technique is grouping data without being based on certain data classes into the same object class. A cluster is a collection of records that are similar to one another and have dissimilarities with the records in another cluster. The aim is to produce groupings of objects that are similar to each other in groups. The greater the similarity of objects in a cluster and the greater the difference between each cluster, the better the quality of cluster analysis (Larose, 2005).

Clustering technique uses the k-means method, which is a method for grouping items into k groups (where k is the desired number of groups). Groups or clusters are formed by minimizing the number of Euclidean distances between data and the corresponding centroid, assuming the average vector as centroid (Wakhidah, 2010).

Computational software used in data processing uses WEKA which is an open source software. Weka is a software that implements various machine learning algorithms to carry out several processes related to information retrieval or data mining systems. Some excellent features possessed by WEKA Classification. There are many algorithms in WEKA that support the classification process of an object and the user is facilitated to implement it directly. The user can load the dataset, choose an algorithm for classification, then be given some data representation that represents the results of the accuracy, the error rate of the classification process.

RESULTS AND DISCUSSION

The results of data processing using WEKA software with k-means clustering technique obtained the following output illustrated Figure1.

```
Scheme:    weka.clusterers.SimpleKMeans -init 0 -max-candidates 100 -periodic-pruning 10000 -min-density 2.0 -t1 -1.25 -t2 -1.0 -N 2 -A "weka.core.EuclideanDistance -R first-last" -I 500 -num-slots 1 -S 10
Relation:   data olahan
Instances:  42
Attributes: 8
        KM1
        KM2
        KM3
        KM4
        KM5
        KM6
        KM7
        KM8
Test mode:   evaluate on training data
```

Figure 1. Listing program and data processing using WEKA software

The output shows that there are 42 data processed with 8 attributes of multiple intelligences, the accuracy of this model is 80%. The algorithm is run by determining the number of clusters in advance, namely as many as 2 clusters and 10 seeds, using Euclidian distance with 500 iterations.

```
Final cluster centroids:
            Cluster#
Attribute   Full Data     0       1
            (42.0)     (20.0)   (22.0)
=============================
KM1       37.7857    40.85      35
KM2       38.0714    40.65   35.7273
KM3       36.2619     39.4   33.4091
KM4        37.5      39.8   35.4091
KM5       35.3095    38.45   32.4545
KM6       38.6905    41.55   36.0909
KM7       36.9286    40.15      34
KM8       34.9048    37.55    32.5
```

```
Time taken to build model (full training data) : 0 seconds

=== Model and evaluation on training set ===
Clustered Instances
0      20 ( 48%)
1      22 ( 52%)
```

Figure 2. Output data simulation using WEKA software

From the data above, clustering results show that there are 20 students (48%) included in cluster 0 which is a tendency to have 8 levels of multiple intelligence a little higher than the other 22 students (52%). The results of the plot between each type of intelligence, there are 28 combinations of plots, the following can be seen in Figure 3. A result of the plots between mathematical

logic intelligence and musical intelligence has a relationship or concern. In such conditions it can be said that one intelligence with another can care for one another so that it will provide solutions to the problems faced, this is called multiple intelligences.
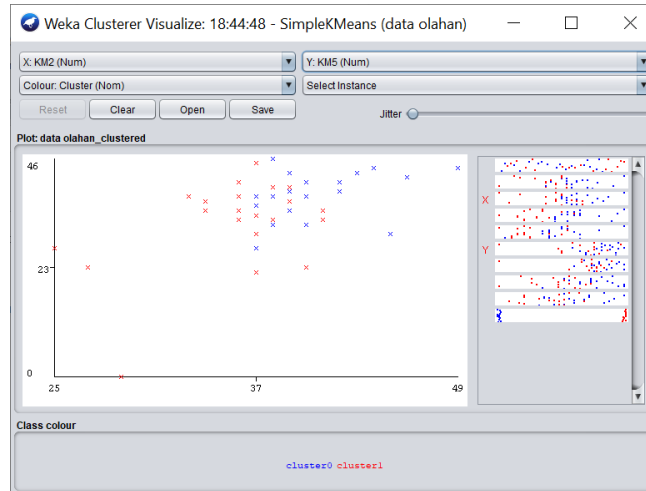

Figure 3. Plot between mathematical logic intelligence and musical intelligence

While the percentage figures obtained from the two clusters for each type of intelligence can be seen in the following Figure 4.
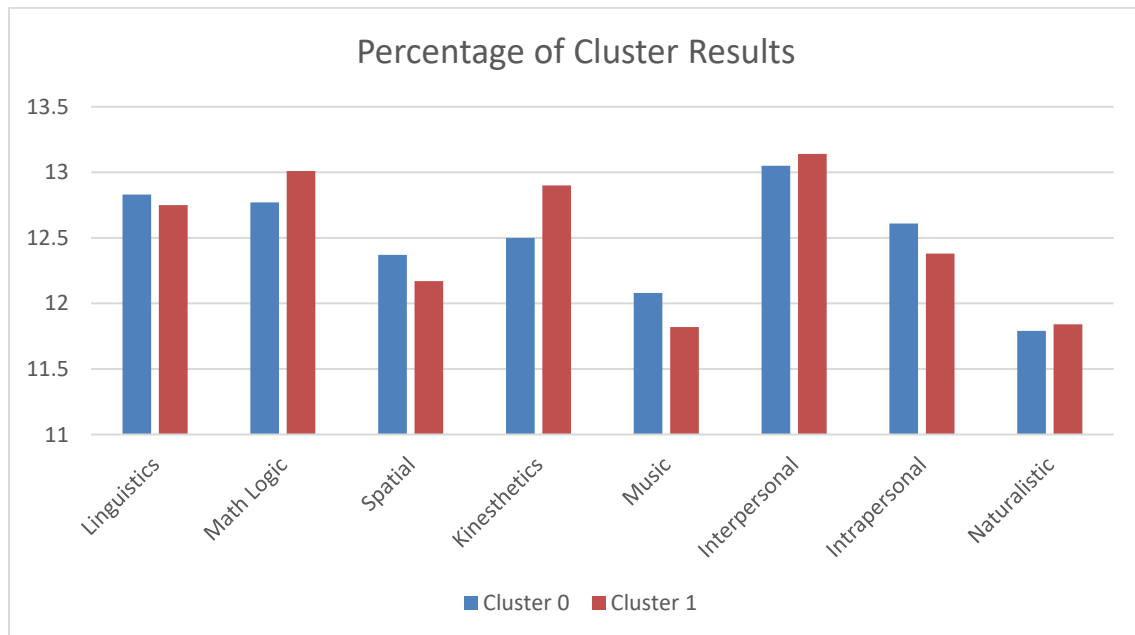

Figure 4. Percentage of cluster results

From Figure 4, the first cluster is the highest tendency of students have 13.05% of interpersonal intelligence of namely

communication built directly against the interlocutor (face to face), the lowest is naturalistic intelligence of 11.79%, namely

expertise in recognizing and classifying certain features in the surrounding environment, while other intelligence is almost entirely around 12%. In the second cluster, the highest tendency of students have 13.14% interpersonal intelligence which is followed by logical mathematics intelligence of 13.01%, and the lowest is music intelligence and naturalistic, while other intelligences are around 12%.

CONCLUSIONS
The theory of multiple intelligences developed by Gardner appears to be owned by students in class 1 at MI Al-Inayah Pasar Rebo, East Jakarta. The results of clustering technique with the k-means method obtained 2 clusters consisting of 20 students (48%) are in the first cluster (0) which is slightly higher than the compound intelligence of 22 other students (52%) who are in the second cluster (1). However, the difference is not too significant when viewed based on the percentage obtained in each of the multiple intelligences for the two clusters. The highest intelligence of 13.14% is shown in interpersonal intelligence in the second cluster and 13.05% in the first cluster, which means that students have communication skills that are built directly against the interlocutor (face to face). Another high intelligence is logical mathematics intellegence, this supports the learning process of mathematics in the classroom. The implications of the results of the study can be used as a guide for teachers in developing a learning method that is tied to the type of intelligence possessed by students, so that learning objectives are achieved well.

ACKNOWLEDGMENT

CONFLICT OF INTEREST
All author was declare there is no conflict of interest.

REFERENCES

1. Abdi, A., Laei, S., & Ahmadyan, H. (2013). The Effect of Teaching Strategy Based on Multiple Intelligences on Students' Academic Achievement in Science Course. Universal Journal of Educational Research, 1(4), 281-284.
2. Amir, A. (2013). Pembelajaran Matematika dengan Menggunakan Kecerdasan Majemuk (Multiple Intelligences). Logaritma: Jurnal Ilmu-Ilmu Pendidikan Dan Sains, 1(01). https://doi.org/10.24952/LOGARITMA.V1I01.196
3. Baş, G., & Beyhan, Ö. (2010). Effects of multiple intelligences supported project-based learning on students' achievement levels and attitudes towards English lesson. International Electronic Journal of Elementary Education, 2(365–386).
4. Behling, O. (n.d.). Employee Selection: Will Intelligence and Conscientiousness Do the Job? The Academy of Management Executive (1993-2005), Vol. 12, pp. 77–86. https://doi.org/10.2307/4165443
5. Berman, B., & Evans, J. R. (2001). Retail Management: A Strategic. Approach. New Jersey: Prentice Hall.
6. Chan, D. W. (2008). Giftedness of Chinese students in Hong Kong: Perspectives from different conceptions of intelligences. Gifted child quarterly, 52(1), 40-54.
7. Cardenas, F. de J. N., Camacho, J. H., Mariano, V. T. T., & Redondo, A. M. F. (2010). International journal of combinatorial optimization problems and informatics. In International Journal of Combinatorial Optimization Problems and Informatics (Vol. 6). Retrieved from https://ijcopi.org/index.php/ojs/article/view/59
8. Dunn, R. (2000). Learning styles: Theory, research, and practice. National Forum of Applied Educational Research Journal, 13(1), 3–22.
9. Masoud, S., Maryam, R., Sadegh, R., Mahnaz, M., Mahmoud, B. A Review of Medicinal Plants Affecting Exercise and Physical Health Factors in Athletes(2019) Journal of Complementary Medicine Research, 10, pp. 212-225.
10. Gardner, H. (1993). Multiple Intelligences The Theory In Practice. New York: Basic Books.
11. Gardner, H. (2003). Kecerdasan Majemuk (Multiple Intelligences) Teori dalam Praktek. Terjemahan oleh Alexander Sindoro. Batam: Interaksa.
12. Goleman, & Daniel. (2009). Kecerdasan emosional /Daniel Goleman; Alih bahasa T. Hermaya. Koleksi Buku UPT Perpustakaan Universitas Negeri Malang, 0(0). Retrieved from http://library.um.ac.id/free-contents/printbook2.php/koleksi-digital-perpustakaan-35704.html
13. Larose, D. T. (2005). Discovering Knowledge in Data : An Introduction to Data Mining. New Jersey: John Willey & Sons, Inc.
14. Muthmainnah, R. N., Ismah, & Ramadhan, A. I. (2019). 3D geometric shapes of pop-up book for visually disabled students. International Journal of Scientific and Technology Research, 8(9), 1423-1426
15. Mokhtar, I. A., Majid, S., & Foo, S. (2008). Information literacy education: Applications of mediated learning and multiple intelligences. Library & Information Science Research, 30(3), 195-206.
16. Rozalena, R., & Kristiawan, M. (2017). Pengelolaan Pembelajaran PAUD dalam Mengembangkan Potensi Anak Usia Dini. JMKSP (Jurnal Manajemen, Kepemimpinan, Dan Supervisi Pendidikan), 2(1). https://doi.org/10.31851/JMKSP.V2I1.1155
17. Santrock, J. W. 2007. (2007). Psikologi Pendidikan. Jakarta: Kencana.
18. Suarca,K.,Soetjiningsih,S.,&Ardjana,I.E.(2016).KecerdasanMajemukpadaAnak.SariPediatri,7(2),85.https://doi.org/10.14238/sp7.2.2005.85-92
19. Sulaiman, T., Abdurahman, A. R., & Rahim, S. S. A. (2010). Teaching Strategies Based on Multiple Intelligences Theory among Science and MathematicsSecondarySchoolTeachers.Procedia-SocialandBehavioralSciences,8,512518.https://doi.org/10.1016/J.SBSPRO.2010.12.070
20. Turban, E. (2005). Decision Support Systems and Intelligent Systems Edisi Bahasa Indonesia Jilid 1. Yogyakarta: Andi.
21. Wakhidah,N.(2010).ClusteringMenggunakanKMeansAlgorithm.JurnalTransformatika,8(1),33.https://doi.org/10.26623/transformatika.v8i1.45
22. Software WEKA. https://www.cs.waikato.ac.nz/ml/weka/downloading.html