Research Report for Odd Semester 2022/2023

Designing Rules Based on Fuzzy Logic in the Selection of Learning Media in Computer Programming Algorithms Course

Liza Efriyanti [1]

[1] Islamic Education Management Study Program, Postgraduate Program, State Islamic University Sjech M.Djamil Djambek Bukitttinggi, Bukittinggi, Indonesia

ABSTRACT

Masih banyak dosen dalam perkuliahan baik secara teori maupun praktik mengalami kebingungan mengenai persentase media mana yang diprioritaskan untuk diterapkan dalam setiap pertemuan agar tujuan pembelajaran tercapai secara maksimal. Pemilihan media pembelajaran yang tepat sangat mempengaruhi jenis pembelajaran yang dilakukan baik secara teori maupun praktik, khususnya pada mata kuliah ilmu komputer yang menggunakan kedua jenis tersebut dalam proses perkuliahannya. Penggunaan logika fuzzy dapat membantu pendidik dalam melakukan presentasi berbagai media pembelajaran yang digunakan dalam proses perkuliahan baik secara teoritis maupun praktis, sehingga sangat membantu dosen dalam mengambil keputusan dalam waktu singkat di awal semester media apa yang akan digunakan saat membuat rencana pembelajaran semester pada setiap pertemuan. Dalam penelitian ini, model penelitian R&D ADDIE digunakan. Hasil yang diperoleh dalam penelitian ini berupa desain aturan berbasis logika fuzzy dalam pemilihan media pembelajaran yang tepat untuk perkuliahan teori maupun praktik pada mata kuliah Algoritma Pemrograman Komputer.

ABSTRACT

There are still many lecturers in theory and practice who experience confusion over which media percentages are prioritized to be applied in each meeting so that the main learning outcomes are maximally achieved. Fuzzy logic is one of the tools in artificial intelligence that can provide a decision from a problem that intersects with one another and is blurred so that it provides a good solution. The choice of the right learning media greatly influences the type of learning that is carried out whether in theory or practice, especially in scientific courses. computers that use these two types in the lecture process. The use of media that is suitable for technical implementation of lectures in theory or practice will have an impact on achieving the learning objectives of each lecture meeting. The use of fuzzy logic can assist educators in making presentations of various learning media used in the lecture process both theoretically and practically, so that it greatly assists lecturers in making decisions in a short time at the beginning of the semester when making semester lesson plans. In this study, the ADDIE model of R&D research was used. The results obtained in this study are in the form of fuzzy logic-based rule designs in selecting appropriate learning media for theoretical or practical lectures in Computer Programming Algorithms courses. The designs obtained can be used by lecturers who apply theory and practice in one semester, especially in the field of computer science.

CHAPTER I

PRELIMINARY

A. Background of the problem

Technological developments have had the impact of cultural change in human life, so that it is known as the first industrial revolution until now it has entered the era of the fourth industrial revolution. This also provides a new nuance in the world of education around the world, changes occur both in the processes, strategies and learning models that are applied (Damanik, 2020) .

Artificial intelligence is a product of the development of the industrial revolution, in the 21st century it has made a major contribution in facilitating all aspects of human life (Ramadhan & Putri, 2018) . The science of artificial intelligence is usually studied in computer science majors, but nowadays many courses have been opened under tutoring institutions. This course activity is carried out both online and offline learning with teaching staff who have expertise in the field of computer programs and artificial intelligence, usually more focused on making simple robots. The course participants range from 7 years to 17 years old, which are divided into various structured packages.

In the world of education in general, the science of artificial intelligence can be applied in various fields, one of which is determining the percentage of appropriate use of instructional media in a higher education course (Ramadhan & Putri, 2018) (Gultom, 2017) . With the existence of an artificial intelligence in determining the right media in the learning process, the achievement of learning objectives will be more targeted and student learning outcomes will increase significantly (Arfida & Saputra, 2017) .

There are various methods for designing rules before presenting them in coding programs, namely: rule-based methods, neural networks, fuzzy logic, certainty factor (CF), and genetic algorithms (Dutta, 2018) . The approach used in designing these rules can be done using forward chaining or backward chaining (Sadegh-Zadeh, 2012) (Rafi Aziz et al., 2019) . After getting the rules by involving experts in accordance with the cases made, they are then presented in a program using one of the programming languages and then they can be converted to the form of an application program either web-based or android (Rafi Aziz et al., 2019) .

Educators in the era of society 5.0 can take advantage of the convenience provided by the science of artificial intelligence in choosing suitable media in the subjects or subjects they teach/develop. Especially for educators who are new to teaching or who are already seniors. Students who are diverse in terms of learning styles and also learning culture that are appropriate to their time are certainly a challenge for educators in determining suitable media when the learning process is carried out, especially learning material that is carried out in theory and practice, especially in computer science (Dwi et al. ., 2021) . The selection of suitable media will have an impact on the learning outcomes obtained by students and a better level of understanding of the material whether done in theory or practice.

Fuzzy logic, which is a method for building rules in artificial intelligence, can be used to solve problems in which decisions are intersected with each other (Dutta, 2018) , so that this is suitable for designing rules for choosing the right media in the theoretical learning process. and practice.

Based on the description above, the authors conducted a study to design rules in the selection of learning media in the algorithm logic course in the Informatics and Computer Engineering Education (PTIK) study program, Faculty of Tarbiyah and

Teacher Training, UIN Sjech M.Djamil Djambek Bukittinggi using fuzzy logic . PTIK Study Program, one of the study programs studying computer science, where most of the courses consist of theory and practice in computer laboratories.

B. Formulation of Research Problems

The formulation of the problem in this study: How to design rules in the selection of learning media in the algorithm logic course in the Informatics and Computer Engineering Education (PTIK) study program, Faculty of Tarbiyah and Teacher Training, UIN Sjech M.Djamil Djambek Bukittinggi using fuzzy logic?

C. Research purposes

The purpose of the research is to design rules in the selection of learning media in algorithm logic courses in the Informatics and Computer Engineering Education study program (PTIK), Faculty of Tarbiyah and Teacher Training, UIN Sjech M.Djamil Djambek Bukittinggi using fuzzy logic.

D. Benefits of research

The benefits of research consist of two parts, namely:

1. Theoretical benefits

   The research results are expected to contribute to knowledge in the field of computer science, especially in artificial intelligence and research related to fuzzy logic.

2. Practical benefits

   a. For PTIK Study Program

Provide input in decision making in determining the distribution of credits in practicum courses in the laboratory so that the main achievements in lectures can be achieved optimally.

b. For Lecturers

Provides an overview of the suitability of using media while in class or in a computer laboratory, so that the media is utilized optimally during the learning process.

c. For Students

Maximizing the use of existing media, so that students can make good use of the media, so that it has an impact on the enthusiasm and motivation of students in attending lectures both in class and in computer laboratories.

CHAPTER II

THEORETICAL FOUNDATION

A. Artificial intelligence

1. Definition of Artificial Intelligence

Artificial intelligence (Artificial Intelligence) is part of computer science that studies how to make machines (computers) able to do work like and as well as what humans do, even better than what humans do. According to John McCarthy, 1956, AI: To find out and model human thought processes and design machines so they can mimic human behavior. Intelligent = having knowledge + experience, reasoning (how to make decisions & take action), good morals. In order for machines to be intelligent (act like & as good as humans) they must be equipped with knowledge & have the ability to reason. 2 main parts needed for artificial intelligence applications

a. knowledge base: contains facts, theories, thoughts & relationships between one another.
b. inference engine (inference engine): the ability to draw conclusions based on knowledge

According to Winston and Prendergast (1984), the goals of Artificial Intelligence are:

a. Making machines smarter.
b. Understand what intelligence is.
c. Making machines more useful.

The definition of AI according to Russel and Norvig (Russel, Norvig, 2003)

can be categorized into two main dimensions that discuss the process/reasoning of thinking (reasoning) and behavior/action (behavior). Furthermore, the definition of AI can be further elaborated based on performance and rationality

.

2. Difference between Artificial Intelligence and Natural Intelligence

   Advantages of artificial intelligence:

   a. More permanent. Natural intelligence can change because human nature is forgetful. Artificial intelligence doesn't change as long as computer systems & programs don't change it.
   b. Easier to duplicate & distribute. Transferring human knowledge from 1 person to another requires a very long process & expertise can never be completely duplicated. So if knowledge is located in a computer system, this knowledge can be copied from that computer & can be transferred easily to another computer.
   c. Cheaper. Providing computer services will be easier & cheaper than bringing in someone to do a number of jobs over a very long period of time
   d. Be consistent and thorough because artificial intelligence is part of computer technology, while natural intelligence is always changing
   e. Documentable. Computer-generated decisions can be easily documented by tracking every activity of the system. Natural intelligence is very difficult to reproduce.
   f. Can do some tasks faster and better than humans

   Disadvantages of Artificial Intelligence:

   a. AI applications use concepts such as Artificial Neural Sequences which require powerful tools with perfect computational power to process complex

information. Also, it costs a lot to maintain the equipment and needs to be repaired which adds to the cost .

b. AI is quickly replacing jobs where people have to perform repetitive tasks or show little creativity. For example, industry is replacing humans with robots for product assembly, cleaning, and quality assurance which could cause a major problem of unemployment in the near future.
c. Robots have no emotions, or at least are on a stage compared to humans. This means they can't establish relationships with other humans or machines to solve certain problems which are an important part of troop management.
d. The machine can only perform the task for which it was designed, anything exceeding its limits will result in a crash, system crash, or produce irrelevant output.

Advantages of natural intelligence:

a. Creative: humans have the ability to increase knowledge, whereas in artificial intelligence to increase knowledge must be done through a built system.
b. Allows people to use hands-on experience or learning . Meanwhile, artificial intelligence must receive input in the form of symbolic input.
c. Human thought can be widely used, while intelligence
   very limited production

Lack of Natural Intelligence

a. Natural intelligence is very difficult to produce
b. Natural intelligence is always in flux
c. Natural intelligence can change because of human nature
   possibility to forget.

d. Natural intelligence is slower when compared to intelligence artificial .

e. Natural intelligence is not produced by everyone even if it exists but not everyone can manage the natural intelligence that he has.

3. The difference between Artificial Intelligence and Conventional Programs

Table 1. Differences between Artificial Intelligence and Conventional Programs

	Artificial intelligence	**Conventional Programs**
Processing Focus	Symbolic/numeric concept (knowledge)	Data and Information
Search	heuristics	Algorithm
Input properties	Can Be Equipped	Must Complete
Information	provided	Usually not provided
Structure	Control is separated from knowledge	Control integrated with information (data
Output properties	Quantitative	Qualitative
Reasoning Ability	Yes	Not

Artificial intelligence programs can be written in all computer languages, both in C, Pascal, Basic and other programming languages. However, in subsequent developments, special programming languages were developed for artificial intelligence applications, namely LISP and PROLOG

4. History of Artificial Intelligence

The history of the development of artificial intelligence is divided into several periods which can be described as follows:

a. Forerunner of Artificial Intelligence (1943 – 1955)
    1) The forerunner of AI was done by McCulloh & Pitts with artificial Neurons that mimicked how human neurons work with propositional logic. Can solve computational functions with the structure of neuron networks.
    2) Hebbian learning, introduces simple rules for updating the power between neurons. ♣Minsky & Edmonds built the first neural network computer in 1950.
    3) Allan Turing is considered to be the first person to fully think about AI in his article "Computing machinery and Intelligent" in 1950.

b. The Birth of Artificial Intelligence (1956)
    1) McCarthy initiated the Dartmouth Workshop in 1956 which gave birth to a new field name "Artificial Intelligence".
    2) Why is AI different from other similar disciplines? Because AI focuses on imitating human abilities such as creativity, self-development, and the use of language. In addition, because AI methodology is a branch of computer science that seeks to build machines that function autonomously in complex and changing environments.

c. The beginnings of AI full of enthusiasm and high hopes (1952 – 1969)

    This is the stage of developing a successful AI application when compared to a primitive computer program. Many successful AI applications have given rise to the term “machine evolution”

d. AI becomes an industry (1980 – present)

1) The first commercial application using an expert system called R1 which was used by the company America (1982).
2) Japan is also forming a long-term project of using Prolog-based intelligent computers.

e . Artificial Intelligence as a discipline (1987 – present)

f. AI emerges in all fields (1995 – present)

5. Applications in Artificial intelligence

Main scope of artificial intelligence :

a. Expert system (expert system): a computer as a means to store expert knowledge so that computers have the expertise to solve problems by imitating the expertise of experts. Natural language processing (natural language processing): users can communicate with computers using everyday language, for example English, Indonesian, Javanese, etc., for example Text summarization: a system that can summarize important things from a discourse given.

b. Speech recognition: humans can communicate with computers using voice.

Example :

- Give instructions to the computer by voice,

- Reading aids, for the visually impaired, have input in the form of printed text (eg books) and has output in the form of speech from the given printed text.

c. Robotics & sensor systems

An example is a sensor system in a washing machine that uses an optical sensor, emits light into the water and measures how, the light, gets to the other end. The dirtier it is, the light that gets to it is dimmer. The system is also able to

determine the type of dirt dirt/oil. The system can also determine the right rotation automatically based on the type and amount of dirt and the amount to be washed.

Sensor systems, such as vision and imaging systems, and signal processing systems, are part of robotics. A robot, which is an electromechanical device programmed to perform manual tasks, is not all part of AI

d. Computer Vision (Computer Vision),

is a combination of imaging, image processing, pattern recognition and decision-making processes. The main goal of computer vision is to translate a scene. Computer vision is widely used in quality control of industrial products.

e. Intelligent computer-aided instruction: the computer can be used as a tutor who can train & teach

Example: Learn to speak English

6. Soft Computing

Soft computing is a new innovation in building intelligent systems, namely systems that have human-like expertise in certain domains, are able to adapt and learn so they can work better if environmental changes occur. Soft computing exploits tolerance for imprecision, uncertainty, and partial truths to be resolved and controlled easily to match reality (Prof Lotfi A Zadeh, 1992).

The methodologies used in Soft computing are:

a. Fuzzy System (accommodating inaccuracy) 4 Fuzzy Logic (fuzzy logic)
b. Neural Network (using learning) 4 Artificial Neural Network (neurall network)
c. Probabilistic Reasoning (accommodating uncertainty)

d. Evolutionary Computing (optimization) 4 Genetic Algorithm

B. Fuzzy Logic

Fuzzy logic is a logic that has a fuzzy value or fuzzyness between right and wrong. In classical logic stated that all Thing could expressed in term binary (0 or 1, black or white, yes or no), whereas fuzzy logic allows membership values between 0 and 1, level gray and also black and white, and in shape linguistics, draft no Certain as "a little", "reasonable" and "very". Logic this related withfuzzy sets and probability theory.

This fuzzy logic was introduced by Dr. Lotfi Zadeh of the University of California, Berkeley in 1965. Fuzzy logic can used in the fields of control theory, decision theory, and some inside sections science management. In addition, the advantage of fuzzy logic is the ability toprocess reasoning in a manner language (linguistic reasoning), so that in the design no need equality math from object which controlled. As for one example of the application of fuzzy logic in life everyday is in 1990 was first made washing machine with logic fuzzy in Japan (Matsushita Electric Industrial Company).

Fuzzy system is used for determine round which appropriate in a manner automatic based on type and 2the amount of dirt and the amount to be washed. The inputs used are: how dirty, the type of dirt, and how much was washed. This machine uses sensors optical , Secrete light to water and measure how light theuntil to end other. More dirty, so ray which until more dim.Besides that, the system can also determine the type of dirt (dirt or oil). set fuzzy based on idea for expand range functionsuch a characteristic that the function will include real numbers at intervals [0 ,1]. Fuzzy logic is a way to map an input space to in something room output. Scheme logic fuzzy :

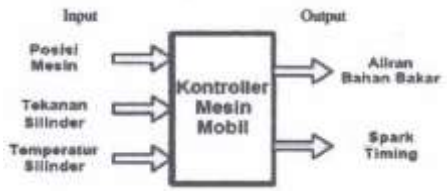
Between inputs and output there is something box black which must map input to output which corresponding. Example :

Mapping input-output on problem production : “given data stock goods, how many total goods which must produced ?"

There are several ways/methods that can work on the black box, for example: fizzy systems, artificial neural networks, linear systems, expert systems, differential equations, etc.

However, according to Prof. Lotfi A. Zadeh, inventor of the fuzzy logic theory in 1960s:

“ on almost all case We could produce something productwithout use logic fuzzy,



however use fuzzy will more fast and more cheap"

1. **History logic Fuzzy**

Fuzzy Logic is the first published artificial intelligence by Prof.Dr. Lotfi Zadeh is from Pakistan. Through this fuzzy logic system can make their own decisions and seem like they have feelings, because have other decisions besides yes (logic 1) and no (logic 0). Therefore fuzzy logic is very different from programming logarithmic paths. For example is a robot that uses fuzzy logic to predict when it should Act or dodge moment there is hindrance in ahead with only there is warning 'beware' and without any mathematical calculations provided by the user. While robots that use conventional programming algorithms do not will could decide alone for dodge from hindrance which there is in ahead.

Fuzzy Logic, which in Indonesian can be interpreted as Logic Blurred or Vague Logic, can be said as "new old logic". Thing this because knowledge about logic fuzzy in a manner modern and methodical found onin 1965, but the concept of fuzzy logic has been inherent in humans, since humans exist. We can easily find the concept of fuzzy logic in behavior man in daily life.

Fuzzy logic is a way to map an input space to inside something room output. Scheme logic fuzzy : Between inputs and output there is something box black which should map the input to the appropriate output. For example: input-mapping output on production problems: "given inventory data, what is the amount goods to be produced?" There are several ways/methods that can be worked on box black the, example : system fuzzy, network nerves imitation, system linear, expert systems, differential equations, etc. However Prof. Lotfi A. Zadeh, founder of logic theory fuzzy in year 1960s _ say: " *on almost all case We could produce a product without using fuzzy logic, but usingfuzzy it will be quicker and cheaper"*

Application Logic Fuzzy:

1. Year 1990 first time machine wash with logic fuzzy in Japan (Matsushita Electric Industrial Company). Fuzzy system is used for determine round which appropriate in a manner automatic based on type and the amount of dirt and the amount to be washed. Inputs used: how much dirty, type dirt, many which washed. Machine this using an optical sensor, shines light into the water and measures how the light got to the other end. Getting dirtier, then sum which until more dim. System also capable determine typedirt it's dirt/oil.
2. Transmission automatic on car Nissan, save petrol 12 – 17 %
3. Train lower land Sendai control termination automatic on area certain
4. Knowledge medical and biology, as system diagnosis cancer
5. Management and taking decision, example system location factory based on logic fuzzy, making games based on logic fuzzy, etc.
6. Knowledge environment, example control quality water, prediction weather.
7. Technique, example planning network computer, prediction exists earthquake earth, etc.
8. etc

2. set And Function Membership

1. set Assertive (crisp)

Firm set (Crisp) is, the membership value of an item x in a set A, which is often written as □A[x], has 2 possibilities,namely: 1. means that the item (x) is a member of the set A0, which means that, those items (x) not a member of the association A,

example :

- S = [1 ,2,3,4,5,6] is universe, talksA = [1,2,3]

B = [3 ,4,5]

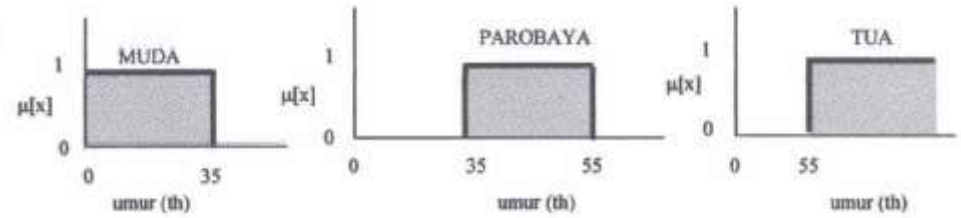
So :

Membership value 2 in the set A □ □ A[2] = 1 because 2 □ A Value membership 3 on set A □ □A[3] = 1 because 3 □ A

Score membership 4 on set B □ □ A[4] = 0 because 4 □ AScore membership 2 on set B □ □A[2] = 0 because 2 □ BScore membership 3 on set A □ □A[3] = 1 because 2 □ B

- For example , the age variable is divided into 3 categories, namely: YOUNG age < 35 years old

PAROBAYA 35 □ age □ 55 years oldOLD age > 55 years



Score membership in a manner graphic, **youth** set , **parobaya, old** :

age 34 years old, it is said that you are **Young** □ □Young[34] = 1 age 35 year so said **Not young** □ □Young[35] = 0 age 35 years then said **Parobaya** □ □Parobaya[35]= 1

are 34 years old, then you say No. **Parobaya** □ □Parobaya[34] = 0 age 35 year not enough 1 day so said **NoParobaya** □

□Parobaya [35th – 1 day] = 0

age 35 year more 1 day so said **Not young** □□Young[35 th

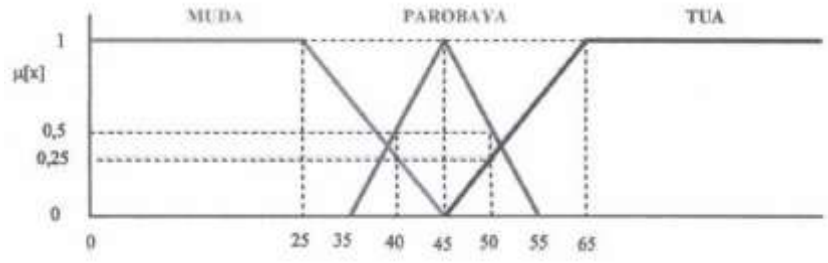
+ 1 day] = 0

set crisp for state age can no fair because existsEven a small change in a

value results in a category difference which enough significant.

2. set Fuzzy

set fuzzy used for anticipate Thing the on. A person can enter into 2 different groups, MUDAand PAROBAYA, PAROBAYA and OLD, etc. How much big its existence in the set can be seen in the value/degree membership. set fuzzy for variable AGE :



age (th)

Age 40 year including deep set YOUNG with

 YOUNG[40]=0.25

Himpunan crisp, nilai keanggotaan hanya 0 dan 1. Himpunan fuzzy, derajat/nilai keanggotaan terletak pada rentang 0 sampai 1 sehingga : Bila x memiliki derajat keanggotaan fuzzy μA [x] = 0 → x bukan anggota himpunan A Bila x memiliki derajat keanggotaan fuzzy μA [x] = 1 → x anggota penuh himpunan A

including also in set PAROBAYA with PAROBAYA

[40] = 0.5 age _ 50 year including in set = OLD with

 OLD[50] = 0.25 incl also in set PAROBAYAwith PAROBAYA [50] = 0.5

3. Function Membership (Memberships function)

Something curve which show mapping dot, dot, dot inputs data to invalue/degree which own intervals Among 0 until 1.

Example chart on is something function membership for variable AGE which is divided into 3 categories or 3 fuzzy sets, namely MUDA, PAROBAYA, OLD, where could represented as following :

$$\mu MUDA[x] = \begin{cases} 1, & x \le 25 \\ \frac{45-x}{45-25}, & 25 < x < 45 \\ 0, & x \ge 45 \end{cases} \qquad \mu TUA[x] = \begin{cases} 0, & x \le 45 \\ \frac{x-45}{65-45}, & 45 < x < 65 \\ 1, & x \ge 65 \end{cases}$$

$$\mu PAROBAYA[x] = \begin{cases} 0, & x \le 45 \\ \frac{x-35}{45-35}, & 45 < x < 65 \\ \frac{55-x}{55-45}, & 45 \le x \le 55 \end{cases}$$

4. Character haziness

Take note statement under this:

- Engine which used continously will fast hot

us no could determine with constant boundary ,fast,and hot

If water shower too hot so raise Genre water cold slowly

us no could determine with appropriate limitation too hot,raise water which cold, and slowly

Then the solution is by using FUZZY LOGIC(logic faint)

5. Variable linguistics

- Variable linguistics = a variable which own score form wordsin language natural no number.
- Why use the word/sentence than number ? because role linguistics of course not enough Specific compared number, however information which be delivered more informative.

For example, if "SPEED" is a linguistic variable, then score linguistics for variable hurry up is, for example "SLOW", "CURRENTLY", "FAST". Thing this corresponding with everyday human habits in assessing something, for example:"He drives the car fast", without giving a score how many the speed.

- Every variable linguistics related listen a function membership.

According to Wang (1997), formal definitions of linguistic variables are given as follows. A linguistic variable is characterized by (X, T(x), U,M), where :

X: Name variable (variable linguistics) which Becomes object

T(x): The set of all terms (values) linguistics which associated with (name) variable (X) which describe the object

U: Domain physical actual/space scope where variable linguistics X take values quantitative / value numeric (crisp) □ setuniverse

M: Something rule semantics which connectcon every score linguistics in Q with something set fuzzy in u

From example on, so obtained:

X = speed

u = [0, 100] □ mean domains/spaces scope speed example from 0up to 100 km/h

T(speed) = {slow, currently, fast}□ mean variable speed divided

Into 3 fuzzy sets, namely slow, medium, fast

So M for every X, M(x) is: M(slow), M(medium), M(fast)

M(slow) = fuzzy set "speed below 40 Km/hour" withfunction membership □ slow

M(medium) = set its fuzzy "speed approach 55 km/hour"with fungi membership □ moderate

M(fast) = its fizzy set. " speed above 70 km/hour"with function membership fast

Picture chart function its membership as following :

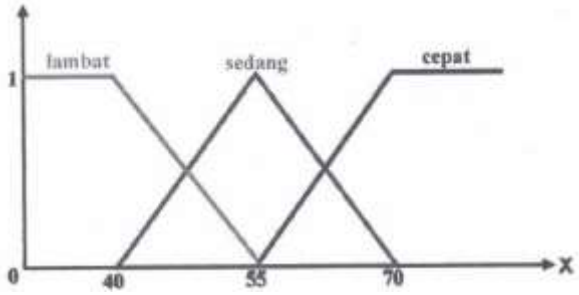


Chart function membership speedSo that set fuzzy for.

M(slow) = {(0,1), (1,1),(2,1), …, (40,1), …, (47,0.533), …, (55,0),(56,0)...

(100 ,0)}

M(medium) = {(0,0), (1,0),(2,0), …, (40.0), …, (47,0.533), …,

(55 ,1),(56,0.933)...(100,0)}

M(fast) ={(0,0), (1,1),(2,1), …, (40,1), …, (47.0), …, (55,0),(56,0.866)...

(100 ,1)}

3. Operation Base set Fuzzy

Used to combine and modify fuzzy sets. Score membership as results from operation 2 set called fire strengthor a predicate.

Table 2. Basic Operations of Fuzzy Sets

Operator	Operation	Function Membership
AND	Intersections	(AB)(x) = min [A(x), B(x)]
OR	Union	min [A(x), B(x)]
NOT	Complements	A(x) = 1 - A(x)

Example :

- u = {1,2,3,4,5,6}

A = {(1,0), (2,0,2), (3,0,6), (4,0,9), (5,1), (6,0,8)}

B = {(1,0,8), (2,1), (3,0,7), (4,0,4), (5,0,1), (6,0)}

So predicate for :

A^c = {(1,1), (2,0,8), (3,0,3), (4,0,1), (5,0), (6,0,2)}

B^c = {(1 ,0.2), (2,0), (3,0.3), (4,0.6), (5,0.9), (6,1)}

A B= {(1 ,0), (2,0.2), (3,0.6), (4,0.4), (5,0.1), (6,0)}

A B= {(1 ,0.8), (2,1), (3,0.7), (4,0.9), (5,1), (6,0.8)}

- Example level membership 27 year on set YOUNG is 0.6(YOUNG[27] = 0.6).

Level membership Rp. 2 million on set income TALLis 0.8.

(HIGH SALARY[2 million] = 0.8) **so** predicate for age YOUNG andearn TALL :

(Young HIGH SALARY = min (YOUNG[27], HIGH SALARY[2 million])

= min(0.6, 0.8) = 0.6

4. Reasoning Monotone

Rule (rules) If-Then Fuzzy

- Rule IF-THEN fuzzy is statement IF-THEN where a number of say- sayin statement is determined by function membership.
- Rule production fuzzy is relax; fuzzy Among two proposition fuzzy.Rule the stated in form:IF (proposition fuzzy 1) THEN (proposition fuzzy 2)
  - Proposition fuzzy is own level truth which stated in something number in shape intervals [0, 1], where correct stated byscore 1 and wrong stated by score 0.
  - The premise of a fuzzy rule can have more than one part (premise1, premix2, ...etc), all parts of the premix are calculated simultaneously and

socam resolved for a single value by use operator fuzzy in set fuzzy.

IF premise 1 AND premise 2 THEN conclusion 1 AND conclusion 2Where : AND is operator fuzzy

premise 1 and premise 2 form variable inputConclusion 1 and conclusion 2 form variable output

Example:

IF request inventory goes down AND production a lot THEN reduced goodsIF request ride AND stock a little THEN production goods increase.

Where :

Request, inventory : variablegoods production input : variableoutput

Down, up : category set fuzzy from Request Lots, little : category set fuzzy from stockReduce, increase : category set fuzzy from production goods

1. Implication Function

Stages of Building a Fuzzy System

The stages of building a fuzzy system depend on the method used, because there are many theories/methods for building fuzzy systems.

2. Fuzzification

= takes input crisp values and determines the degree to which the values are becomes a member of each corresponding fuzzy set make function membership.

Example: input crisp 75 degrees transformed as internal heat shape fuzzy with level membership 0.80.

3. Inference

- apply the rules to the generated fuzzy input in process fuzzification

- evaluate each rule with the input generated from the process fuzzification by evaluating relationships or degrees of membership antecedents/premises every rule.
- Level membership/value truth and premise used for determine score truth part consequent/conclusion

4. Process determination output Crisp Depends theory/method which used.

5. Method Inference Fuzzy with the Tsukamoto Method

Case in point: A canned food company will produce food of the ABC type. Dad data for the last 1 month, the biggest demand reached 5000 packs/day, and Request smallest, until 1000 packaging/day.

Stock goods in warehouse the most until 600 packaging/day, and smallest once 100 packaging/day.

With all its limitations, until now, the company has only been able to produce maximum item 7000 packaging/day, as well as by efficiency machine and HR company produce Very no 2000 packaging.

If process production company the use 4 rule fuzzy :

R1 : IF Request down AND stock many THEN production goodsreduce

R2 : IF Request down AND stock a little THEN production goodsreduce

R3 : IF Request ride AND stock many THEN production goodsincrease

R4 : IF Request ride AND stock a little THEN production goodsincrease

How many packs of main type ABC must be produced, if the quantity demand for 4000 packages and inventory in the warehouse is still 300 packaging?

Solution:

: FUZZIFICATION create function membership

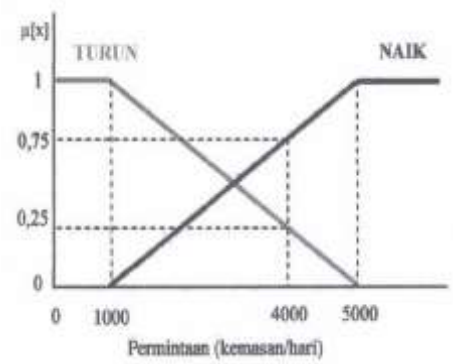
$$\mu per\min taan TURUN[x] = \begin{cases} 1, & x \le 1000 \\ \dfrac{5000-x}{5000-1000} & 1000 < x < 5000 \\ 0, & x \ge 5000 \end{cases}$$

$$\mu per\min taan NAIK[x] = \begin{cases} 0, & x \le 1000 \\ \dfrac{x-1000}{5000-1000} & 1000 < x < 5000 \\ 1, & x \ge 5000 \end{cases}$$

Derajat/nilai keanggotaan : permintaan TURUN[4000]
= (5000 – 4000)/4000
= 0,25

permintaan NAIK[4000]
= (4000 – 1000)/4000
= 0,75

There is 3 variable fuzzy which will modeled, that is : DEMAND Composed on 2

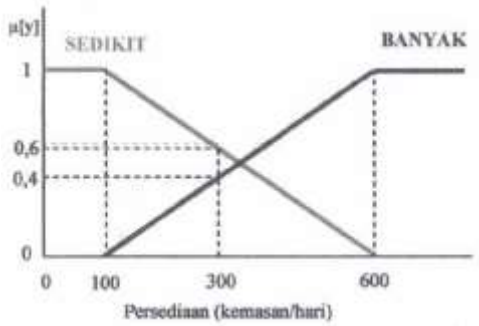


$$\mu persediaanSEDIKIT[x] = \begin{cases} 1, & y \le 1000 \\ \dfrac{600 - y}{600 - 100} & 100 < x < 600 \\ 0, & y \ge 600 \end{cases}$$

$$\mu persediaanBANYAK[x] = \begin{cases} 0, & y \le 1000 \\ \dfrac{Y - 100}{600 - 100} & 100 < x < 600 \\ 1, & y \ge 600 \end{cases}$$

Derajat/nilai keanggotaan :
µpermintaan SEDIKIT[300]
= (600 – 300)/5000
= 0,6

µpersediaan BANYAK[300]
= (300 – 100)/500
= 0,4



h impunity fuzzy that is RIDE and LOWER INVENTORY Consists above 2 set fuzzy that is A LITTLE and MANY

1. PRODUCTION GOODS

Consists on 2 set fuzzy that is REDUCE andINCREASE

$$\mu produksiBERKURANG[z] = \begin{cases} 1, & z \le 2000 \\ \frac{700 - z}{7000 - 2000} & 2000 < z < 7000 \\ 0, & z \ge 7000 \end{cases}$$

$$\mu produksiBERTAMBAH[x] = \begin{cases} 0, & z \le 2000 \\ \frac{z - 2000}{7000 - 2000}, & 2000 < z < 700 \\ 1, & z \ge 7000 \end{cases}$$

DETERMINE OUTPUT CRISP

On method TSUKAMOTO

for determine output crisp use average weighty that is:

$$z = \frac{\alpha 1 z 1 + \alpha 2 z 2 + \alpha 3 z 3 + \alpha 4 z 4}{\alpha 1 + \alpha 2 + \alpha 3 + \alpha 4}$$

$$= \frac{0{,}25 * 5750 + 0{,}25 * 5750 + 0{,}4 * 4000 + 0{,}6 * 5000}{0{,}25 + 0{,}25 + 0{,}4 + 0{,}6}$$

= 7475/1,5 = 4983

Jadi jumlah makanan kaleng yang harus diproduksi 4983 kemasan

C. Relevant Research

The research that is relevant to the research that the authors conducted are as follows:

1. Septilia Arfida and Ridho Binsar Saputra with the research title: Design and Build Multimedia-Based Fuzzy Logic Learning Applications. Research results: Learning applications provide an alternative choice in providing knowledge about Fuzzy Logic courses by using multimedia-based learning media that can help students learn Fuzzy Logic material, built using Action Script2 found in Adobe Flash CS6 and based on animation . So that this learning application is more interesting for students to learn, with the material studied in Fuzzy Logic lectures (Arfida & Saputra, 2017) .
2. Pier Luigi Gentili, with the research title: Implementing Fuzzy Sets and Processing Fuzzy Logic Information by Molecules. Research results: This

contribution supports the hypothesis that the effectiveness of fuzzy logic in mimicking human capability to compute with words is due to the structural and functional analogies between the human nervous system and fuzzy logic systems. Furthermore, this work demonstrates that fuzzy logic can be processed by molecules and chemical reactions in wetware beyond the traditional methods based on electronic circuits and software. This innovative way of processing fuzzy logic allows the development of Chemical Artificial Intelligence and the design of new computational machines, more similar to the brain than electronic computers, both in composition and performance (Gentili, 2022) .

3. Teddy Nasastra, with the research title: Application of Tsukamoto's Fuzzy Logic to Determine Crude Oil (CPO) Production at PT. Tri Bakti Sarimas. Research results: Fuzzy logic is a science that can analyze uncertainty. One method of fuzzy rules is Tsukamoto, which is a method that is often used to build a system whose reasoning resembles human intuition or feelings. The calculation process is quite complex so it takes a relatively long time, but this method gives results with a fairly high accuracy value. PT. Tri Bakti Sarimas is a company that produces large quantities every day. Therefore, planning the amount of crude oil is very important. In order to be able to meet market demand precisely and with the appropriate amount. By using this application, it is hoped that the company can provide convenience for the company to predict the amount of production based on the number of requests and existing inventory data, in order to achieve maximum profits. Keywords: Mamdani Fuzzy Method, PHP, Demand, Inventory, Production (Teddy Nasastra, 2021) .

CHAPTER III

RESEARCH METHODOLOGY

A. Time and Place of Research

Conducting research in the odd semester of the 2022/2023 academic year in the Informatics and Computer Engineering Education Study Program (PTIK) at the Tarbiyah and Teacher Training Faculty of UIN Sjech M.Djamil Djambek Bukittinggi.

B. Types of research

The method used in this study uses the ADDIE Research and Development (R&D) model. ADDIE stands for Analysis, Define, Develop, Implement and Evaluate (Sari et al., 2020). In the analysis stage in the form of data collection, interviews with experts, especially educators in computer science courses and students who have studied algorithms and programming courses. In the define stage, the researcher makes a data table of the learning media used and the learning process data carried out in the programming algorithm course. At the develop stage, the researcher designs a membership function that is used in fuzzy logic by utilizing all the information obtained from educators, which is presented at the define stage. In the implementation stage, the researcher performs fuzzification calculations from the develop stage. The final stage is to evaluate the results of the fuzzification calculations, in order to obtain an accurate picture of the implementation of the learning process that has been carried out by educators, especially in computer programming algorithm courses.

C. Research Stages

The stages of the research carried out in this study were using the ADDIE model (Analyze , Design, Develop, Implement, Evaluate). The following describes the activities carried out at each stage:

1. In the Analyze phase, the researcher made field observations and interviews with lecturers who teach courses in which there is learning in the classroom and practice in computer laboratories.
2. In the Design Stage, the researcher made a data table of the learning media used and the learning process data carried out in the programming algorithm course.
3. In the Developt stage, the researcher designs a membership function that is used in fuzzy logic by utilizing all the information obtained from educators, which is presented in the define stage.
4. In the Implement stage, the researcher performs fuzzification calculations from the develop stage.
5. Evaluate stage, From the results of the fuzzification calculations, in order to obtain an exact picture of the implementation of the learning process that has been carried out by educators, especially in computer programming algorithm courses.

CHAPTER IV

RESULTS AND DISCUSSION

A. Research result

Computer programming algorithm courses serve as a basis for an introduction to designing computer programs before entering the coding stage and mastering various computer programming languages (Dwi et al., 2021). Along with the needs of students studying programming algorithms to practice on their own, because this course is distributed in 3 credits, with details of 3 credits in total in class without any practice in the laboratory. In the programming algorithm course, the material studied is: the history of algorithms, various basic algorithm structures and examples of cases and solutions, flowcharts, introduction to programming languages (C and C ++ languages in the PTIK Study Program, UIN Bukittinggi), presentation of sequential, conditional and looping to C and C++ programming language syntax, Arrays, Subroutines and Sorting. This course is a prerequisite for taking courses in the following semester, for example: databases, data structures, programming languages I , II and III, as well as courses related to coding programs and system design.

As for the results of interviews from lecturers who teach computer programming algorithms, it is obtained data on the learning media used in the form of: whiteboards, printed books, lecture modules both hardcopy and softcopy and video tutorials made by the lecturer concerned which can be viewed or downloaded from YouTube, data then the criteria and values are made as shown in table 1. While the learning process carried out during lectures consists of 2, namely in theory and practice which has also been given criteria and values, this can be seen in table 2.

Table 1. Learning Media Data Used in Programming Algorithm Courses

No	Use of learning media	Criteria	Score
1	Whiteboard	Tall	80-100
		Currently	40-85
		Low	10-50
2	Printed book	Tall	85-100
		Currently	45-90
		Low	10-50
3	Lecture Module	Tall	85-100
		Currently	55-90
		Low	10-50
4	Video tutorials	Tall	80-100
		Currently	40-85
		Low	30-50

Table 2. Data on the Learning Process Conducted in the Programming Algorithm Course

No	Classroom Learning Process	Criteria	Score
1	Theory	Tall	75-100
		Currently	60-80
		Low	10-70
2	Practice	Tall	80-100
		Currently	70-90
		Low	65-75

In making rules on fuzzy logic using membership functions. Membership functions in fuzzy logic can be presented in the form of: linear function up/down, trapezoidal, or triangular (Pakyürek et al., 2019) (Nasution & Prakarsa, 2021) . Formation of membership functions in fuzzy logic based on input and output variables from the problems encountered and information from respondents or experts in their fields (Arfida & Saputra, 2017) .

So the input variables in this study are: blackboards, printed books, lecture modules and video tutorials, with the following membership functions:

a. blackboard ;

$$\mu_{low} = \begin{cases} 0;\ x \leq 10\ atau\ x \geq 50 \\ (x-10)/(25-10);\ 10 \leq x \leq 25 \\ (25-x)/(50-25);\ 25 \leq x \leq 50 \end{cases} \quad (1)$$

$$\mu_{medium} = \begin{cases} 0;\ x \leq 40\ atau\ x \geq 85 \\ (x-40)/(62{,}5-40);\ 40 \leq x \leq 62{,}5 \\ (62{,}5-x)/(85-62{,}5);\ 62{,}5 \leq x \leq 85 \end{cases} \quad (2)$$

$$\mu_{height} = \begin{cases} 0;\ x \leq 80\ atau\ x \geq 100 \\ (x-80)/(90-10);\ 80 \leq x \leq 90 \\ (90-x)/(100-90);\ 90 \leq x \leq 100 \end{cases} \quad (3)$$

b. printed book ;

$$\mu_{low} = \begin{cases} 0;\ x \leq 10\ atau\ x \geq 90 \\ (x-45)/(67{,}5-45);\ 45 \leq x \leq 67{,}5 \\ (67{,}5-x)/(90-67{,}5);\ 67{,}5 \leq x \leq 90 \end{cases} \quad (4)$$

$$\mu_{\text{medium}} = \begin{cases} 0;\ x \leq 10 \text{ atau } x \geq 50 \\ (x-10)/(25-10);\ 10 \leq x \leq 25 \\ (25-x)/(50-25);\ 25 \leq x \leq 50 \end{cases} \quad (5)$$

$$\mu_{\text{height}} = \begin{cases} 0;\ x \leq 85 \text{ atau } x \geq 100 \\ (x-85)/(92{,}5-85);\ 85 \leq x \leq 92{,}5 \\ (92{,}5-x)/(100-92{,}5);\ 92{,}5 \leq x \leq 50 \end{cases} \quad (6)$$

c. Lecture module ;

$$\mu\text{low} = \begin{cases} 0;\ x \leq 10 \text{ atau } x \geq 60 \\ (x-10)/(30-10);\ 10 \leq x \leq 30 \\ (30-x)/(60-30);\ 60 \leq x \leq 30 \end{cases} \quad (7)$$

$$\mu\text{medium} = \begin{cases} 0;\ x \leq 55 \text{ atau } x \geq 90 \\ (x-55)/(72{,}5-55);\ 55 \leq x \leq 72{,}5 \\ (72{,}5-x)/(90-72{,}5);\ 72{,}5 \leq x \leq 90 \end{cases} \quad (8)$$

$$\mu\text{height} = \begin{cases} 0;\ x \leq 85 \text{ atau } x \geq 100 \\ (x-85)/(92{,}5-85);\ 85 \leq x \leq 92{,}5 \\ (92{,}5-x)/(100-92{,}5);\ 92{,}5 \leq x \leq 100 \end{cases} \quad (9)$$

d. Video tutorials ;

$$\mu\text{low} = \begin{cases} 0;\ x \leq 30 \text{ atau } x \geq 50 \\ (x-30)/(40-10);\ 30 \leq x \leq 40 \\ (40-x)/(50-40);\ 40 \leq x \leq 50 \end{cases} \quad (10)$$

$$\mu\text{medium} = \begin{cases} 0;\ x \leq 40 \text{ atau } x \geq 85 \\ (x-40)/(60-40);\ 40 \leq x \leq 60 \\ (60-x)/(85-60);\ 60 \leq x \leq 85 \end{cases} \quad (11)$$

$$\mu\text{height} = \begin{cases} 0;\ x \leq 80 \text{ atau } x \geq 100 \\ (x-80)/(90-80);\ 80 \leq x \leq 90 \\ (90-x)/(100-90);\ 90 \leq x \leq 100 \end{cases} \quad (12)$$

While the output variables are in the form of: theory and practice with the following membership functions:

a. theory ;

$$\mu low=\begin{cases} 0;\ x \le 65 \text{ atau } x \ge 75 \\ (x-65)/(70-65);\ 65 \le x \le 70 \\ (70-x)/(75-70);\ 70 \le x \le 75 \end{cases} \quad (13)$$

$$\mu medium=\begin{cases} 0;\ x \le 70 \text{ atau } x \ge 90 \\ (x-70)/(80-75);\ 90 \le x \le 75 \\ (80-x)/(90-80);\ 80 \le x \le 90 \end{cases} \quad (14)$$

$$\mu height=\begin{cases} 0;\ x \le 80 \text{ atau } x \ge 100 \\ (x-80)/(90-80);\ 80 \le x \le 90 \\ (90-x)/(100-90);\ 90 \le x \le 100 \end{cases} \quad (15)$$

b. practice ;

$$\mu low=\begin{cases} 0;\ x \le 10 \text{ atau } x \ge 70 \\ (x-10)/(40-10);\ 10 \le x \le 40 \\ (40-x)/(70-40);\ 40 \le x \le 70 \end{cases} \quad (16)$$

$$\mu medium=\begin{cases} 0;\ x \le 60\ atau\ x \ge 80 \\ (x-60)/(70-60);\ 60 \le x \le 70 \\ (70-x)/(80-70);\ 70 \le x \le 80 \end{cases} \quad (17)$$

$$\mu low=\begin{cases} 0;\ x \le 75 \text{ atau } x \ge 100 \\ (x-75)/(87{,}5-75);\ 75 \le x \le 87{,}5 \\ (87.5-x)/(100-87.5);\ 87.5 \le x \le 100 \end{cases} \quad (18)$$

B. Discussion

The selection of learning media in the lecture process will determine the appropriate learning process carried out by the lecturer which plays an important role in achieving the learning objectives of a main achievement of the lecture process from each lecture meeting held for one semester (Simanjuntak, 2019) (Efriyanti & Annas, 2020) . In computer science, the lecture system is carried out in theory and practice, so an intelligent system is needed that can assist lecturers in making the right choice of technical teaching in class, whether in theory or practice based on the selection of learning media used by students and lecturers as a determinant of which media to use. on a priority scale.

Media in the learning process is an intermediary tool in conveying messages, material, feelings, and attention. Learning is a process of communication that exists between teachers and students. Another definition of learning media is the tools, methods, and techniques used in delivering material between teachers and students in the educational process so that learning goes according to its objectives (Raharjo & Pitaloka, 2020) (Dwi et al., 2021) . Learning media plays an important role in the learning process. The learning media that will be created later are in accordance with the needs of students used in the learning process. With the existence of media, the learning that students follow is more varied so that it is not boring and does not seem monotonous. There are various kinds of learning media, including: 1) Audio media, namely channeling audio messages to recipients, for example radio, telephone and so on, 2) Visual media, namely media that rely on the sense of sight, for example photos, posters, maps, graphics and so on. , 3) Audio-visual media, namely media that displays sound and images, for example, such as TV, sound films and so on, 4) Diversity media, namely media that is adapted to the potential in an area that is used as learning media

for example blackboards, reality, three-dimensional media and learning resources from the community, 5) Photographic images, namely from several sources, for example, such as paintings, cartoons, newspapers, 6) Maps and globes, namely presenting location data such as mountains, rivers, land, earth and so on (Khomarudin & Efriyanti, 2018) .

The initial stage of the research carried out the analysis phase. At this stage the researcher conducted observations and interviews. Interviews were conducted with lecturers who teach courses in the field of computer science, which in the learning process apply learning in theory and practice. Researchers also conducted interviews with students about the media used in theoretical and practical courses in PTIK study program.

In the second stage, the define stage, the researcher made a data table of the learning media used and the learning process data carried out in the programming algorithm course, which can be seen in Tables 1 and 2.

Meanwhile, in the third stage, the develop stage, the researcher designed a fuzzy membership function based on the define stage. Based on information from experts in the use of instructional media in computer science and using theory in fuzzy logic, several rules are obtained from the membership function of both the input and output variables:

Table 3. Fuzzy Logic Rule Design Results

No. Rules	Rule Statements
R1	If the blackboard media is high and the printed book is high then the learning process is high
R2	If the printed book media is medium and the lecture module is high, then the practical learning process is high
R3	If the video media is high and the lecture module is moderate, then the practical learning process is moderate

R4	If the blackboard media is medium and the tutorial videos are low and the lecture modules are medium then the practical learning process is low
R5	If video media is low and printed books are moderate, then the learning process is moderate

At the implement stage, using the Tsukamato method, the rules that have been obtained are implemented with the membership functions that have been built using fuzzy logic (Nasution & Prakarsa, 2021) (Teddy Nasastra, 2021) (Anugrahwaty & Azmi, 2019) . As for the steps taken, if the input values are known (83;60;75,5;90), then obtained:

Blackboard = 83, using formula (3):

$$\mu_{\text{blackboard height}} = \frac{(x-80)}{(90-80)} = \frac{3}{10} = 0.3$$

Printed books = 60 by using formula (4):

$$\mu_{\text{medium print book}} = \frac{(x-45)}{(67,5-45)} = \frac{25}{22,5} = 1,1$$

Lecture Module = 75 .5 by using formula (8):

$$\mu_{\text{Lecture Module}} = \frac{(75,5-70)}{(90-72,5)} = \frac{2,5}{17,5} = 0\ ,14$$

Video Tutorial = 90, using formula (12):

$$\mu_{\text{video tutorials}} == \frac{10}{10} = \frac{(90-80)}{(100-90)} 1$$

Then the results of each input calculation above are entered into each R1 to R5, so that the values α 1 to α 5 are obtained, and the values X1 to X5 are obtained. For the calculation as follows:

R1 = if the blackboard media is high and the printed book is high then the learning process is high

α 1 = Min ($\mu_{\text{board height}} \cap \mu_{\text{high print book}}$)

= Min(0.3 ; 1.1)

= 0.3

X1= $\frac{(Z1-Zmin)}{(Zmax-Zmin)}$= $\frac{x-75}{87,5-75}$= $\frac{(x-75)}{(12,5)}$=α 1

= $\frac{(x-75)}{(12,5)}$=0 ,3

x-75 = 3.75

x = 3 .75 +75

x = 78 .75

R2 = if the printed book media is moderate and the lecture module is high then the practical learning process is high

α 2 = Min $\mu_{\text{medium printed book}} \cap \mu_{\text{higher education module}}$

= Min(0 ; 0)

= 0

X2= $\frac{(Z1-Zmin)}{(Zmax-Zmin)}$= $\frac{x-80}{100-80}$=α 2

= $\frac{(x-80)}{(20)}$=0

x-80 = 0

x=80

R3 = if the video media is high and the lecture module is medium then the practical learning process is moderate

α 3 = Min (μ high video ∩μ moderate lecture module)

= Min(1 ; 0.14)

= 0.14

X3= $\frac{x-70}{80-75}$=α 3

= $\frac{(x-70)}{(5)}$=0 ,14

x-70 = 0.7

x = 70 .7

R4 = if the blackboard media is medium and video tutorials are low and lecture modules are moderate then the practical learning process is low

α 4 = Min (μ medium whiteboard ∩μ low video ∩medium lecture module)

= Min(0; 0; 0.14)

= 0

X4= $\frac{x-65}{75-70}$=α 4

= $\frac{(x-65)}{(5)}$=0

x-65 = 0

x=65

R5 = if video media is low and printed books are moderate, then the learning process is moderate

α 5 = Min ($\mu_{\text{low video}} \cap \mu_{\text{medium print book}}$)

= Min(0; 1.1)

= 0

X4= $\frac{x-60}{70-60}$=α 5

= $\frac{(x-60)}{(10)}$=0

x-60 = 0

x=60

so that in the defuzification stage, to determine the output of crips, a centralized average defuzification is used, namely ;

$$Z=\frac{(\propto 1*X1+\propto 2*X2+\propto 3*X3+\propto 4*X4+\propto 5*X5)}{\propto 1+\propto 2+\propto 3+\propto 4+\propto 5}$$

$$Z=\frac{(0,3*78,75+0*80+0,14*70,7+0*65+0*60)}{0,3+0+0,14+0+0}$$

$$Z=\frac{(23,625+0+9,898+0+0)}{0,44}$$

$$Z=\frac{33,523}{0,44}$$

Z = 76.188

Based on the Z value that has been obtained, the last stage is carried out in the form of the evaluate stage, namely the value obtained provides an overview of the decisions that need to be taken by educators, that when using a blackboard is at a value of 83, printed books at a value of 60, lecture modules at a value of 75.5, and video tutorials at a value of 90, using the fuzzy logic method the educator applies the learning process in theory in class more precisely than practice in the laboratory so that learning outcomes are achieved according to learning outcomes/objectives.

CHAPTER V

Conclusions and recommendations

A. Conclusion

The results of fuzzy logic calculations using the Tsakomoto method manually by knowing the input and output variables and the rules that have been built using fuzzy logic will make it easier to make decisions quickly. The use of media that has been determined by the lecturer, in an intelligent system that uses fuzzy logic can provide technical output values such as what is suitable for the lecture process which is applied whether in theory or practice quickly. Based on the case examples that the researchers did, a score of 76.18 was obtained so that educators with existing learning media inputs had the learning process carried out during appropriate lectures in the form of theory.

B. Suggestion

So that in future research a mobile-based application can be made in determining the right media decisions to use when learning in class or in the laboratory along with their presentations.

BIBLIOGRAPHY LIST

Anugrahwaty, R., & Azmi, F. (2019). Analysis of Production Planning Predictions with Tsukamoto's Fuzzy Logic. *Syncron - Informatics Engineering Journal & Research* , *1* (2), 13–16.

Arfida, S., & Saputra, RB (2017). Design and Build Multimedia-Based Fuzzy Logic Learning Applications. *Journal of Jupiter* , *9* (2), 10.

Damanik, EL (2020). *Social Life of the 21st Century: Understanding the Fourth Industrial Revolution in Indonesia The 21st Century Social Life: Understanding the Fourth Industrial Revolution in Indonesia* . *1* , 41–65.

Dutta, DAK (2018). An Application to Support Stuttering People by Implementing Linguistic Variable Based on Fuzzy Logic. *International Journal of Computer (IJC)* , *28* (1), 174–179. http://ijcjournal.org/index.php/InternationalJournalOfComputer/article/view/1175%0A

Dwi, Z., Damopolii, P., & Takdir, R. (2021). Designing Audio Visual-Based Learning Media in Looping Material for Algorithm and Basic Programming Courses, State University of Gorontalo. *[1] Z. Dwi, P. Damopolii, and R. Takdir, "Designing Audio Visual-Based Learning Media in Looping Material for Algorithm and Basic Programming Courses, State University of Gorontalo," Vol. 1, No. 2, 2021.* , *1* (2), 1–11.

Efriyanti, L., & Annas, F. (2020). Mobile Learning Application as a 21st Century Learning Tool for Educators and Students in the Industrial Revolution 4.0 era. *Journal Educative : Journal of Educational Studies* , *5* (1), 29. https://doi.org/10.30983/educative.v5i1.3132

Gentili, PL (2022). *Implementing Fuzzy Sets and Processing Fuzzy Logic Information by*

Molecules . 94. https://doi.org/10.3390/proceedings2022081094

Gultom, DA (2017). Application of Artificial Intelligence in Solving Number Shifting Games on the Star of David with Breadth-First Search Methods and Heuristic Search Using Visual Programming Language. *ISD Journal* , *2* (2), 2528–5114.

Khomarudin, AN, & Efriyanti, L. (2018). Development of Android-Based Mobile Learning Learning Media in Artificial Intelligence Courses. *Journal Educative : Journal of Educational Studies* , *3* (1), 72. https://doi.org/10.30983/educative.v3i1.543

Nasution, VM, & Prakarsa, G. (2021). Designing a Fuzzy Logic Application for Predicting Positive Cases of Covid-19 Using the Tsukamoto Method. *Budidarma Informatics Media Journal* , *5* (4), 1642. https://doi.org/10.30865/mib.v5i4.3338

Pakyürek, M., Aydin, Y., & Mikail, N. (2019). Fuzzy logic applications in horticulture and a sample design for juice volume prediction in pomegranate (Punica Granatum L.). *Applied Ecology and Environmental Research* , *17* (2), 2449–2460. https://doi.org/10.15666/aeer/1702_24492460

Rafi Aziz, A., Muhammadiyah Jember, U., Karimata, J., & Timur Daryanto, J. (2019). IMPLEMENTATION OF BACKWARD CHAINING FOR EXPERT SYSTEMS FOR ANDROID-BASED SHEEP DISEASE DIAGNOSIS. In *Journal of Computer Information Systems and Information Technology (SISKOMTI)* (Vol. 1, Issue 2).

Raharjo, NE, & Pitaloka, GK (2020). Development of Android Application-Based Learning Media with Augmented Reality for Class X Engineering Drawing Subjects of Building Construction, Sanitation and Maintenance at State Vocational High School 1 Seyegan. *Journal of Civil Engineering Education* , *2* (1), 65–77. https://doi.org/10.21831/jpts.v2i1.31966

Ramadhan, HA, & Putri, DA (2018). Big Data, Artificial Intelligence, Blockchain, and Financial Technology in Indonesia. *Directorate General of Informatics Applications,*

Ministry of Communication and Informatics , 1–66. https://aptika.kominfo.go.id/wp-content/uploads/2018/12/Kajian-Kominfo-CIPG-compressed.pdf

Sadegh-Zadeh, K. (2012). Fuzzy Logic. *Philosophy and Medicine* , *113* (2), 993–1041. https://doi.org/10.1007/978-94-007-2260-6_30

Simanjuntak, MDR (2019). Building Student 4 C Skills in Facing the Industrial Revolution 4.0. *Proceedings of the National Seminar on the Faculty of Social Sciences, State University of Medan* , *3* , 921–929.

Teddy Nasastra. (2021). APPLICATION OF TSUKAMOTO'S FUZZY LOGIC TO DETERMINE PRODUCTION OF CRUDE OIL (CPO) AT PT. TRI BAKTI SARIMAS. *JuPerSaTek* , *4* (2), 1589–1597.