

**Profession recommendation based on multiple intelligence for high school students****Heribertus Ary Setyadi<sup>a\*</sup>, Supriyanta<sup>a</sup>, Diyah Ruswanti<sup>b</sup>, and Hartati Dyah Wahyuningsih<sup>c</sup>**<sup>a</sup>*Engineering And Informatics Faculty, Bina Sarana Informatika University, Surakarta, Indonesia*<sup>b</sup>*Science, Technology and Health Faculty, Sahid University, Surakarta, Indonesia*<sup>c</sup>*Engineering And Informatics Faculty, Dharma AUB University, Surakarta, Indonesia***CHRONICLE***Article history:*

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*Keywords:**Profession**Multiple intelligences**Bayes' theorem**Weighted product***ABSTRACT**

One of the problems students often face is the lack of understanding of their interests and talents which will cause confusion in making future study choices and career plans. Career selection is an expression of personality into the world of work followed by identification of certain occupational stereotypes. Eight intelligences according to dr. Howard Gardner is linguistic, logical, mathematical, visual spatial, musical, kinesthetic, interpersonal, intrapersonal, and naturalist. This research purpose is to develop a system that produces information and professional recommendations that are in accordance with multiple intelligences of prospective high school students using a combination of Bayes' theorem and weighted product (WP) method. User's preference value is calculated using the Bayes' Theorem method to give each multiple intelligence value which is a criterion. WP method calculation to find professions that match user preferences. Weight of each criterion needed in WP method is calculated by Rank Order Centroid method. WP calculation will produce a ranking of 3 professions according to the input from the user. From system testing results that compared to results from experts, an accuracy of 67.33% is obtained. Based on the accuracy value, it can be said that the accuracy level system is quite good.

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**1. Introduction**

In the 21st century education system, students are encouraged to have an ability to solve problems, are trained to think critically, evaluate information and be able to work in teams to collaborate productively with other students (Nulhakim & Berlian, 2020). Educators are required to play an active role in the learning process to familiarize students with critical, innovative and even creative thinking in solving a problem (Permana et al., 2021). The goal of Indonesian education is to develop the potential of students to have faith and piety to the Almighty, have noble character, be healthy, knowledgeable, capable, creative, independent and become responsible citizens. To achieve this goal, the Indonesian government implements the 2013 Curriculum which is based on integrated knowledge, behavior and skills competencies to create productive, creative and innovative students who are able to compete in the globalization era (Ernawati et al., 2019). Various learning methods and strategies must be continuously improved to meet global demands. Indonesia must apply the concept of education that refers to various fields. The application of program variations can make student development better (Hilyana & Khotimah, 2021). Every student is required to develop by solving a variety of problems from various fields to fulfill continuous learning and participate effectively in society. Exploration of interesting issues and materials can provide opportunities for students to practice a lot of intelligence with activities that can influence learning and build knowledge (Fadloli et al., 2021).

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One of the problems that is often faced by students is a lack of knowledge about the interests and talents possessed. This can lead to difficulties in making choices about future study plans and careers (Khatijatussalihah et al., 2022). Most intellectual abilities or emotional intelligence students have never been tested, only a few have been tested for planning and career counseling (Asrowi et al., 2020). Factors that influence career decision making include GPA, gender, parents' occupation and income, intelligence tests, and aptitude tests. If there is no support for students to identify themselves in career preparation, then they will most likely have a career that does not match their talents or interests (Rasheed et al., 2022). Basically, career choice is an expression or expansion of personality into the world of work followed by identification of certain occupational stereotypes. There are six career environment models: realistic, investigative, artistic, social, enterprising and conventional (Ayriza et al., 2020).

Everyone has a unique blend of intelligence. Which of the several types of intelligence can one have (Andreana & Putri, 2020). To be said to be intelligent or not, one usually only needs to carry out a standardized test to measure individual intelligence from a psychologist or educator (Abe & Chikoko, 2020). The requirements are seen from IQ, general intelligence, general cognitive abilities, and general mental abilities (Dodd et al., 2022). Oftentimes a person's intelligence is simply defined as IQ (Intelligences Quotient) (Pham, 2020). In fact, IQ has been considered as the only indicator of a person's intelligence, whereas the IQ test only measures intelligence which includes language intelligence and mathematical logic. Real intelligence is more than just linguistic and logical intelligence (Alilateh & Widyantoro, 2019). Eight intelligence according to dr. Howard Gardner are linguistic, logicmathematic, visual spatial, musical, kinesthetic, interpersonal, intrapersonal, and naturalist (Kurniawati et al., 2021). Gardner challenged school education and ancient science thinking that people are born with general cognitive abilities that can be easily measured by short answer tests. Conversely, Multiple Intelligence can provide a new theory with several types of intelligence that can reflect different ways to interact with the world. Everyone has a unique blend of intelligence (Kotova et al., 2021). The Multiple Intelligence theory states that everyone has different talents and different dominant talents. The most important aspect is that from the development of talents that are more dominant, the results will show the individual's progress (Mayub & Fahmizal, 2022).

Bayes' theorem is an approximation to an uncertainty as measured by probability. Bayes' theorem was put forward by Thomas Bayes around 1950. Bayes' theorem has several advantages, namely, it is easy to understand and only requires simple coding, faster in calculations (Ramadhani et al., 2021). Bayes theorem is a fundamental statistical approach in pattern recognition. The Bayesian method is a very effective method used in learning based on training data, using conditional probabilities as a basis (Ningsih, 2020). In Bayes' theorem, the first step of the calculation is to find the universal value of the hypothesis (H) contained in the evidence, then add up all the probability values of the evidence from experts (Vangara et al., 2020). Weight product (WP) is one method of decision making that is more efficient and requires shorter calculation time. Used to solve a problem using multiplication to connect the criterion values, where the value of each criterion must be raised to the power of the criterion concerned (Handrizal et al., 2022). WP method is similar to the Weighted Sum (WS) method, it's just that the WP method has a multiplication of mathematical calculations. The WP method is also known as dimensional analysis because its mathematical structure eliminates one size (Sa'ad et al., 2020). The WP method is an arrangement of alternative decisions that are explained in several ways by decision criteria. So this method does not need to be normalized (Sahoo et al., 2022).

Decision support system for determining the profession that is produced in this research can provide information and recommendations for professions that are in accordance with the intelligence of prospective senior high school students. Knowing the interests and talents of these students can facilitate the process of learning and teaching activities so that students absorb material and the results obtained can be more optimal, and are not confused about determining careers in the future.

## **2. Literature review**

### *2.1 Relevant research*

Previous research entitled Expert System For Career Early Determination Based On Howard Gardner's Multiple Intelligence aims to develop an expert system using Forward chaining method that can help students to be able to recognize their potential. Eight components of Multiple Intelligence that are used are in accordance with Howard Gardner's opinion, they are : verbal-linguistic, logic-mathematical, visual-spatial, rhythmic-music, kinesthetic, interpersonal, intrapersonal and naturalist intelligence. Expert system was developed using desktop programming using Visual Basic 6 (Wulansari et al., 2022).

Research by Fatmasari and Supriyatna entitled Election and Career Development Based on Interest, Talent and Personality Teenagers Using Forward Chaining developed a web-based expert system using Forward Chaining method. The theory used in determining type of career uses Holland's theory, in which there are six career personality types known as RIASEC. Six career environment models according to John Holland are realistic, investigative, artistic, social, enterprising and conventional types. There are 108 statements that must be answered by the user and then the system will display test's results in pdf files (Fatmasari & Supriyatna, 2019).

In a journal entitled Selecting multiple intelligences on children with weighted product, analytical hierarchy process, simple additive weighting and TOPSIS, it aims to determine student intelligence based on multiple intelligences to classify intelligence and know how to learn based on the eight intelligences (Ahsan et al., 2019). This research does not create a system or program, it only uses the SPSS 22.0 tool which is used to process data from questionnaire results.

The final result is a comparison of the four methods used and a graph of the results of filling out the respondent's questionnaire in determining intelligence based on multiple intelligence.

## 2.2 Multiple intelligence theory concept

Multiple intelligence is a model that differentiates a person's intelligence into certain modalities. According to Gardner, everyone has different types of intelligence and no one intelligence is considered higher than another. Intelligence is also defined as a personal tool or talent possessed by someone who may be more in some ways than others (Koolnaphadol et al., 2022). At the core of Gardner's theory of multiple intelligences is an appreciation of the uniqueness that each individual possesses. Learning styles are diverse and use several methods to evaluate them with many ways to make it happen. Artificial intelligence further assists teachers, parents or academic supervisors in identifying the strengths and weaknesses of a student or a child (Agustin et al., 2021).

## 2.3 Bayes' theorem and weighted product concept

Bayes' theorem, taken from an English mathematician in the 18th century named Thomas Bayes. Bayes' theorem is a probability theorem in statistics that is used to calculate the probability of an event based on several past events (Chuan et al., 2023). Bayes' theorem is a theorem that has two different interpretations. As Bayes explains, this theorem shows the extent to which a person's subjective beliefs must change reasonably in response to new clues or information (Vural & Telceken, 2022). Bayes' theorem uses statistics to determine trade-offs between various decisions, using the probabilities and values that go along with each option. A technique for overcoming the problem of data ambiguity into definite data (Laila & Hasugian, 2022).

Weighted Product (WP) is a method in a multi-criteria decision support system that aims to solve problems using data that contains various attributes. WP are popular in DSS because of their speed and ease of selection in a specific order in a rating system (Putra et al., 2022). WP method is similar to Weighted Sum (WS) method, it's just that WP method has multiplication in mathematical calculations. WP method is also referred to as dimensional analysis because its mathematical structure eliminates the unit size of a data object. Does not carry out the data normalization process (Sinaga & Sianipar, 2021). WP method is one level above the Simple Additive Weighting Method and one level below that of the Electre Method, both in terms of the difficulty of the calculations and the relatively short steps (Utami & Febriningrum, 2023).

## 3. Method

Fig. 1 is a conceptual framework for the course of the research from initial observations until creating a web based program.

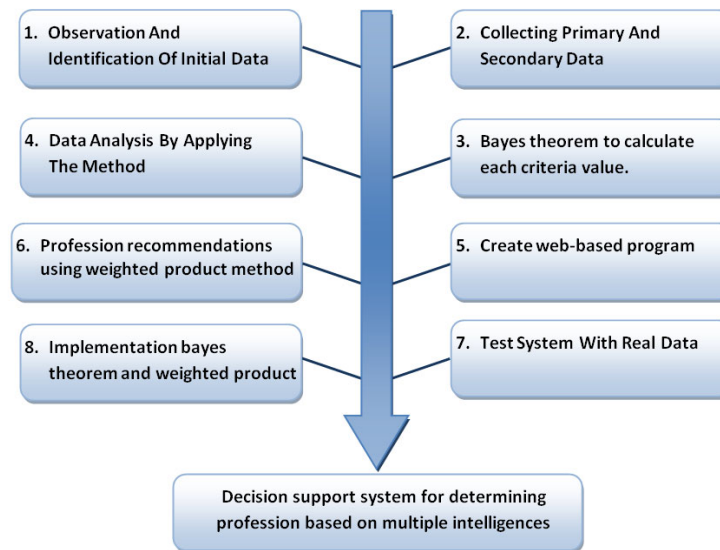


Fig. 1. Research Conceptual Framework

In this research using secondary data and primary data. Secondary data used in this research is data on the characteristics of multiple intelligences which contains 40 statements along with their probability values for each multiple intelligences adapted from research by Huda, entitled Expert System for Talent Detection in Children Aged 4 to 6 Years Using the Bayes Theorem Method (Huda, 2017). There are 8 types of intelligence (code I1 to I8). Each intelligence has different main characteristics, main characteristics have a higher probability value than other intelligences. Each intelligence also has a probability value of occurrence without looking at other criteria, in this case the criteria are characteristics of intelligence. Multiple intelligence data is presented in Table 1.

**Table 1**  
Multiple intelligence data

No	Code	Intelligence Type	Quantity	Event's Probability Regardless of Preference Criteria
1	I1	Linguistik	6	0.14
2	I2	Matematis-Logis	6	0.14
3	I3	Visual-spasial	5	0.12
4	I4	Musical	6	0.14
5	I5	Kinestetik	5	0.12
6	I6	Naturalis	6	0.14
7	I7	Interpersonal	4	0.09
8	I8	Intrapersonal	4	0.09
Total			42	

Characteristics and their relationship to each intelligence presented in Table 2. These characteristics will be the material's preference by the user. There are 40 statements of intelligence characteristics that will be used in this decision support system, symbolized by C1 to C40.

**Table 2**  
Characteristics of multiple intelligences

No	Multiple	Characteristics	Code
1	Linguistik (I1)	Enjoys chatting with others	C1
		Happy to share what he knows	C2
		Easily remembers people's names, or little things they've heard	C3
		Likes to read	C4
		Likes to imitate writing	C5
		Able to listen and retell well	C6
2	Matematis- Logis (I2)	Likes anything related to numbers	C7
		Calculate quickly	C8
		Familiar with calculation operations	C9
		Enjoy games related to logic, such as puzzles, chess and others	C10
...	...	...	...
8	Intrapersonal (I8)	Prefer silence (quiet type)	C39
		Appreciate the things you have	C40
		Lebih suka diam (pendiam)	C39
		Menghargai benda yang dimiliki	C40

Probability value for each intelligence characteristic is presented in Table 3. This value was adapted from Huda's research, where in his data research was obtained directly from experts. Each characteristic has a probability value for each intelligence. These values will later be calculated to find out what intelligence is more prominent in the user, based on user preferences.

**Table 3**  
Data on probability of characteristics of each multiple intelligence

Code	Linguistik (D1)	Matematis-logis	Visual- Spasial	Musical (D4)	Kinesthetic (D5)	Naturalis	Inter	Intra
C1	0.9	0.1	0.05	0.2	0.05	0.1	0.5	0.1
C2	0.9	0.1	0.2	0.05	0.05	0.2	0.2	0.1
C3	0.9	0.1	0.05	0.2	0.05	0.1	0.3	0.3
C4	0.8	0.1	0.1	0.1	0.1	0.1	0.05	0.1
C5	0.8	0.1	0.2	0.1	0.1	0.1	0.1	0.1
C6	0.95	0.2	0.2	0.1	0.1	0.1	0.3	0.24
C7	0.2	0.8	0.1	0.1	0.05	0.05	0.1	0.2
C8	0.2	0.9	0.1	0.1	0.2	0.1	0.1	0.1
C9	0.3	0.8	0.2	0.1	0.2	0.1	0.1	0.2
C10	0.1	0.85	0.3	0.1	0.2	0.1	0.05	0.1
C11	0.05	0.9	0.2	0.1	0.2	0.1	0.2	0.1
C12	0.2	0.8	0.1	0.05	0.1	0.1	0.3	0.3
C13	0.1	0.1	0.9	0.2	0.3	0.2	0.1	0.1
C14	0.15	0.1	0.95	0.1	0.1	0.2	0.2	0.2
C15	0.05	0.15	0.8	0.1	0.2	0.1	0.1	0.2
...	...	...	...	...	...	...	...	...
C41	0.1	0.05	0.2	0.05	0.1	0.25	0.1	0.9
C42	0.1	0.15	0.15	0.1	0.1	0.2	0.1	0.95

Primary data is data obtained through direct interviews with experts, regarding this the author conducted interviews with 4 psychology experts, they are Mr. Muhammad Japar who works as a Psychology lecturer, Mrs. Farida Hidayati works as a Psychology lecturer, Mrs. Agustina Dwi Wardani works as a counseling guidance teacher at Senior High School, and Mr. Agus Kristianto works

as HRD in a private company. All data obtained through the interviews are professional data which total 23 professions and their relationship in multiple intelligences. Characteristics of multiple intelligences from experts is presented in Table 4.

**Table 4**  
Characteristics of multiple intelligences

Code	Profession	Multiple Intelligences Priority to Professions			
		Very important	important	Quite	Not too important
K1	Programmer	P2, P3	P8	P1, P6	P4, P5, P7
K2	Arsitek	P2, P3	P6, P1	P7, P8	P4, P5
K3	Designer	P3	P5, P6	P2, P8	P1, P4, P7
K4	Photographer	P3	P5, P6, P4	P2, P8	P1, P7
K5	Athlete	P5	P3, P8, P6	P2, P4	P1, P5
K6	Dancer	P5, P4	P3	P2, P6	P1, P7, P8
K7	Musician	P1, P4	P8	P2, P3, P6	P5, P7
K8	Komposer musik	P4	P8	P1, P2, P3, P6	P5, P7
K9	Translator	P1	P8	P2, P6, P7	P3, P4, P5
K10	Manager	P8	P1, P2	P3, P8	P4, P5, P6
...	...	...	...	...	...
K22	Director	P2	P1, P7, P8	P3	P4, P5
K23	Teacher	P1, P7	P3, P5, P8	P2	P4, P6

Initial stage is that the user selects the appropriate statement by marking the checklist box and ignoring the statement that does not suit him. Furthermore, preference data is calculated using the Bayes Theorem method to give a value to each multiple intelligence which is a criterion in a profession decision support system. Bayes theorem formula for calculating double evidence is:

$$p(H_1|E_1 E_2 E_3 \dots E_m) = \frac{p(E_1|H_1) \times p(E_2|E_2|H_1) \times \dots \times p(E_m|H_1) \times p(H_1)}{\sum_{k=1}^n p(E_1|H_k) \times p(E_2|E_2|H_k) \times \dots \times p(E_m|H_k) \times p(H_k)} \tag{1}$$

$p(E_1|H_1)$  : probability of evidence emergence E, if the hypothesis  $H_i$  occurs  
 $p(H_i)$  : probability  $H_i$  ignores any evidence

After each criterion value is known, next process is calculating using weighted product method to find professions that match user’s preferences. In calculating weighted product, it takes a weight for each criterion. Weights are used to prioritize criteria for each alternative. Rank order centroid (ROC) method used to determining criteria weight. ROC weighting can usually be expressed as an equation

$$W_m = \frac{1}{m} \sum_{i=1}^m \frac{1}{i} \tag{2}$$

Results of WP calculation will be ranked based on the 3 higher alternative values which will be the output of this system, that is professions that are in accordance with the user's multiple intelligences.

**4. Result and discussion**

*4.1 Bayes' theorem calculation*

Bayes Theorem calculation aims to calculate criteria value, that is multiple intelligences value. First step is to retrieve user preference data, then calculate probability value of user preference. Probability value is obtained from database that was previously entered. Following is calculation for determining criteria value using Bayes theorem method if it assumes following user characteristics:

1. (C1) Enjoys chatting with other people
2. (C2) Likes to tell about what he knows
3. (C10) Likes games related to logic, such as puzzles
4. (C12) Can explain things logically
5. (C15) Like judging pictures or paintings
6. (C17) Can read plans or maps well
7. (C37) Friendly people around
8. (C38) Be open in communication
9. (C42) Enjoys doing things alone

From user preference data, probability values will be taken from each characteristics selected by user. Next step is to calculate the probability value using Bayes Theorem method to obtain the criterion value, that is multiple intelligences. Bayes Theorem calculation using Eq. (1) and the results are:

$$\begin{aligned}
 p(H_1|E_1E_2 E_{10}E_{12} E_{15} E_{17} E_{37} E_{38} E_{42}) &= \frac{0.9 \times 0.1 \times 0.2 \times 0.05 \times 0.1 \times 0.1 \times 0.1 \times 0.14}{0.0567} \\
 &= 0.038 \\
 p(H_2|E_1E_2 E_{10}E_{12} E_{15} E_{17} E_{37} E_{38} E_{42}) &= \frac{0.1 \times 0.1 \times 0.85 \times 0.8 \times 0.15 \times 0.2 \times 0.1 \times 0.05 \times 0.15 \times 0.14}{0.0567} \\
 &= 0.072 \\
 p(H_3|E_1E_2 E_{10}E_{12} E_{15} E_{17} E_{37} E_{38} E_{42}) &= \frac{0.05 \times 0.2 \times 0.3 \times 0.1 \times 0.8 \times 0.9 \times 0.2 \times 0.2 \times 0.15 \times 0.12}{0.0567} \\
 &= 0.5225 \\
 p(H_4|E_1E_2 E_{10}E_{12} E_{15} E_{17} E_{37} E_{38} E_{42}) &= \frac{0.2 \times 0.05 \times 0.1 \times 0.05 \times 0.1 \times 0.1 \times 0.2 \times 0.2 \times 0.1 \times 0.14}{0.0567} \\
 &= 0.0009 \\
 p(H_5|E_1E_2 E_{10}E_{12} E_{15} E_{17} E_{37} E_{38} E_{42}) &= \frac{0.05 \times 0.05 \times 0.2 \times 0.1 \times 0.2 \times 0.2 \times 0.1 \times 0.2 \times 0.1 \times 0.12}{0.0567} \\
 &= 0.0016 \\
 p(H_6|E_1E_2 E_{10}E_{12} E_{15} E_{17} E_{37} E_{38} E_{42}) &= \frac{0.1 \times 0.2 \times 0.1 \times 0.1 \times 0.1 \times 0.1 \times 0.1 \times 0.2 \times 0.2 \times 0.14}{0.0567} \\
 &= 0.0038 \\
 p(H_7|E_1E_2 E_{10}E_{12} E_{15} E_{17} E_{37} E_{38} E_{42}) &= \frac{0.5 \times 0.2 \times 0.05 \times 0.3 \times 0.1 \times 0.1 \times 0.8 \times 0.9 \times 0.1 \times 0.09}{0.0567} \\
 &= 0.3266 \\
 p(H_8|E_1E_2 E_{10}E_{12} E_{15} E_{17} E_{37} E_{38} E_{42}) &= \frac{0.1 \times 0.1 \times 0.1 \times 0.3 \times 0.1 \times 0.1 \times 0.1 \times 0.2 \times 0.95 \times 0.09}{0.0567} \\
 &= 0.0345
 \end{aligned}$$

Based on the calculation above, the value of each criterion is as follows:

Linguistik (I1) = 0.0381  
 Matematis- Logis (I2) = 0.072  
 Visual-spasial (I3) = 0.5225  
 Musikal (I4) = 0.0009  
 Kinestetik (I5) = 0.0016  
 Naturalis (I6) = 0.0038  
 Interpersonal (I7) = 0.3266  
 Intrapersonal (I8) = 0.0345

#### 4.2 Weighted Product Method Calculation

WP method calculation aims to find alternatives, namely professions based on user criteria that have been calculated previously using Bayes Theorem method. Criteria obtained are calculated using WP method, but before calculating using WP, each criterion is weighted against alternative using Rank Order Centroid (ROC) method using equation (2). Assumption of weighting criteria on alternatives with attributes of 2 intelligences is very important, 1 intelligence is important and 3 intelligences is quite important:

$$\begin{aligned}
 W_1 &= \frac{\left(\frac{1}{1} + \frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{4} + \frac{1}{4}\right) \times \frac{1}{2}}{8} = 0.5 & W_5 &= \frac{\left(0 + 0 + 0 + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{4} + \frac{1}{4}\right) \times \frac{1}{3}}{8} = 0.19 \\
 W_2 &= \frac{\left(\frac{1}{1} + \frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{4} + \frac{1}{4}\right) \times \frac{1}{2}}{8} = 0.5 & W_6 &= \frac{\left(0 + 0 + 0 + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{4} + \frac{1}{4}\right) \times \frac{1}{3}}{8} = 0.19 \\
 W_3 &= \frac{\left(0 + 0 + \frac{1}{2} + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{4} + \frac{1}{4}\right) \times \frac{1}{1}}{8} = 0.25 & W_7 &= \frac{\left(0 + 0 + 0 + 0 + 0 + 0 + \frac{1}{4} + \frac{1}{4}\right) \times \frac{1}{2}}{8} = 0.6525 \\
 W_4 &= \frac{\left(0 + 0 + 0 + \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{4} + \frac{1}{4}\right) \times \frac{1}{3}}{8} = 0.19 & W_8 &= \frac{\left(0 + 0 + 0 + 0 + 0 + 0 + \frac{1}{4} + \frac{1}{4}\right) \times \frac{1}{2}}{8} = 0.6525
 \end{aligned}$$

In this method calculation simulation, authors use 10 alternatives out of 23 alternatives. Data on relationship of interest criteria to alternatives is presented in table 4. After obtaining weight value of each criterion for alternative, then S-Vector calculation is performed for each alternative by multiplying all criteria to the power of weight previously calculated using the ROC method. Complete calculation results of S-Vector are presented in Table 5.

$$\begin{aligned}
 S_1 &= (0.072^{0.49}) \times (0.523^{0.49}) \times (0.034^{0.24}) \times (0.038^{0.18}) \times (0.004^{0.18}) \times (0.0009^{0.09}) \times (0.0016^{0.09}) \times (0.33^{0.09}) = 0.0048 \\
 S_2 &= (0.072^{0.52}) \times (0.523^{0.52}) \times (0.038^{0.27}) \times (0.004^{0.27}) \times (0.327^{0.15}) \times (0.034^{0.15}) \times (0.004^{0.063}) \times (0.004^{0.063}) = 0.0037
 \end{aligned}$$

**Table 5**  
Simulation S-vector calculation method

Vector-S	Vector-S Value
S <sub>1</sub>	0.00479
S <sub>2</sub>	0.00371
S <sub>3</sub>	0.00240
S <sub>4</sub>	0.00042
S <sub>5</sub>	0.00040
S <sub>6</sub>	0.00014
S <sub>7</sub>	0.00031
S <sub>8</sub>	0.00079
S <sub>9</sub>	0.00358
S <sub>10</sub>	0.00865

After getting all the S-Vector values, next process is to carry out V-Vector calculations by dividing each S-Vector value by total S-Vector values. Complete calculations results and value ranking are presented in Table 6.

Total Sum of All S-Vectors:

$$\sum_{j=1}^n (X_j)^{w_j} = 0.00479 + 0.00371 + 0.0024 + 0.00042 + 0.0004 + 0.00014 + 0.00031 + 0.00079 + 0.00358 + 0.00865 = 0.02518$$

$$V_1 = \frac{0.00479}{0.02518} = 0.19025$$

$$V_2 = \frac{0.00371}{0.02518} = 0.14727$$

**Table 6**  
Simulation V-Vector Calculation Method And Value Ranking

Calculation		Ranking	
Vector-S	Vector-V Value	Vector-S	Vector-V Value
S <sub>1</sub>	0.19025	S <sub>10</sub>	0.34337
S <sub>2</sub>	0.14727	S <sub>1</sub>	0.19025
S <sub>3</sub>	0.09526	S <sub>2</sub>	0.14727
S <sub>4</sub>	0.01671	S <sub>9</sub>	0.14207
S <sub>5</sub>	0.01594	S <sub>3</sub>	0.09526
S <sub>6</sub>	0.00543	S <sub>8</sub>	0.03156
S <sub>7</sub>	0.01213	S <sub>4</sub>	0.01671
S <sub>8</sub>	0.03156	S <sub>5</sub>	0.01594
S <sub>9</sub>	0.14207	S <sub>7</sub>	0.01213
S <sub>10</sub>	0.34337	S <sub>6</sub>	0.00543

Based on simulation calculation method results, it can be concluded that V-Vector value from 3<sup>rd</sup> order, the highest values are V<sub>10</sub>, V<sub>1</sub> and V<sub>2</sub>. From Vector-V ranking results, it can be concluded that profession outputs are manager, programmer and architect.

4.3 System testing

In developing a system, it is necessary to have a system testing stage, to assess whether system is running as it should (Iskandar & Marjuki, 2022). Testing process is carried out by comparing the results of system calculations with results given by experts directly. In testing system will use test data as many as 50 high school students who have filled out decision support system for determining professions based on multiple intelligences. System output for each student is in form of 3 professions consulted with experts then system's results are compared with professional recommendations results from expert observations. From 50 test data, results output will be calculated, which are same as expert recommendations results. Same results will be divided by total output of the profession from 50 test data, that are totaling 150 to get accuracy system level. 50 user data that has entered preferences according to their personality. user data and their preferences are presented in Fig. 2 and Fig. 3.

Fig. 2. User Data

Fig. 3. User Preference Data and Intelligence Value

In the first stage, system will calculate each criteria value, that is value of each intelligence based on preferences selected by user using Bayes' Theorem calculations. Next process after obtaining each criteria value is to retrieve data from the 23 professions along with predetermined criteria weights, which will then be processed to obtain an S-Vector value. S-Vector calculation is processed by considering criteria values and each criteria weight. After obtaining S-Vector values for each profession data, calculations will then be carried out to determine V-Vector values.

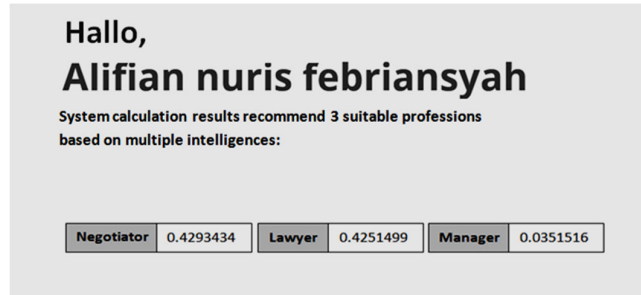


Fig. 4. User Preference Data and Intelligence Value

This value is a comparison S-Vector values of each profession divided by total S-Vectors. System output is professions with 3<sup>rd</sup> highest scores. Output display of 50 data users is presented in table 7.

**Table 7**  
Output Comparison of System Results with Expert Observation Results

User	System	Experts	True	Total
User1	poet, translator, musician	poet, musician, translator	3	3
User2	poet, teacher, singer	poet, journalist, singer	2	3
User3	teacher, designer, singer	designer, photographer, lawyer	1	3
User4	accountant, manager, composer	accountant, scientist, designer	1	3
User5	accountant, programmer, designer	designer, programmer, Architect	2	3
...	...	...	...	...
User50	manager, translator, counselor	manager, translator, accountant	2	3
Total			101	150

Based on Table 7, correct alternatives total is 101 out of 150 alternatives. From these data system accuracy can be calculated by dividing correct alternatives total by all alternatives from 50 test data.

$$\text{System Accuracy} = \frac{101}{150} \times 100\% = 67,33\%$$

**5. Conclusions**

Multiple intelligences used in this research are eight intelligences according to Howard Gardner, they are linguistic, logical mathematical, visual spatial, musical, kinesthetic, naturalist, interpersonal and intrapersonal. Secondary data contains 42 statements and their probability values for each multiple intelligences were adapted from Huda's research. Primary data was obtained from interviews with four psychologists and practitioners. From primary data obtained 23 types of professions and their relationship with multiple intelligences.

Based on the system that has been developed in this study which aims to produce professional recommendations based on multiple intelligences using the Bayes Theorem and Weighted Product methods, it is able to assess a person's level of intelligence and provide professional recommendations that match the value of intelligence quite well. Accuracy level obtained on the system with the highest 3 alternatives using 50 test data is 67.33%. From the accuracy level obtained by the system, it can be concluded that Bayes Theorem and Weighted Product can provide quite good support in choosing a profession based on multiple intelligences.

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