Personal Decision Support:

An Intelligent Personality Decision Aid

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Abstract— **Decision-making system is used to facilitate people in making the right choice for their important daily activities. As for youth population, a proper guidance in making these important decisions is needed. Their skills in making decisions by using a helpful decision aid could indirectly affect their future. For that reason, this study focuses on the intelligent aspects in the development of an intelligent decision aid application. The aid integrates Personality Traits (PT) and Multiple Intelligence (MI) data in the development of a computerized personal decision aid for youths named as Youth Personal Decision Aid (YouthPDA). This study concerns on the helpfulness of the aid based on the hybrid intelligent process through four dimensions; reliability, decision making effort, confidence, and decision process awareness. The evaluation results indicated that for all the four dimensions, YouthPDA is accepted as a helpful tool for youths in making decision.**

Keywords- component; decision support, multiple intelligence, personality traits, youth personal decision aid

I. INTRODUCTION

Decision support especially computerized decision support is very crucial in many areas and for each level of person. The decision systems are able to facilitate people in making the right choice with the available options. The uses of decision making system are mainly in study (program selection) as well as career developments are in demand, especially from the youths (Norfiza et. al., 2013).

In general, youth or also known as adolescent is a group of 15-24 years old teenagers. Youths need to play an important role to ensure that they will be valuable for the future. Therefore, all decisions that are made, especially those which involve learning and their careers should be given very serious attention. The study by Norfiza et.al. (2013) also found that youths tend to decide decision on their own and get advice from parents and their family, but not from professional advisors. Besides that, a study by Khasmohammadi *et al.* (2010) showed that youths have uncertainty in making their own decisions because of parental perfectionism.

Obviously, someone is more likely to consider the options available to him to decide. However, this manual way may not be suitable for the more important things. This is because there may be some information that is not known in detail, but it affects the decisions that are made (Abbas, 2007). The choice comes from the way of thinking or what comes immediately in mind without considering the other aspects that are more important.

Lately, a lot of areas have been refurbished in terms of technology, including decision-making. Personal decision-making is essential to everyone for suggestions that can help simplify the process of determining the best option for a person. This is explained further by Zhang, Miao and Luo (2011) in which technology development is very necessary for a person to manage personal matters by providing constructive suggestions. If there is lack of an effective decision making system, someone will have the possibility to make less precise decisions (Payne & Bettman, 2002).

A clear guidance to make important decisions is expected to avoid adverse effects on youth's future and consequently to the development plan of the country. This demonstrates how a person makes decisions could greatly influence his life. If the decision made is inaccurate, the long term effects of this will be regretted for a significant period of time.

The focus of this study emphasizes on YouthPDA application development that includes two areas, a learning management and career for young adults. The main focus is on the method of creating the intellectual elements in combining main theories. Therefore, the YouthPDA produced was designed to help these young people make decisions in certain areas by presenting the options as a result of their backgrounds that have been processed. This is in line with Chen, Hu, Kuo, and Liang (2010) who believed that online computer management software that is able to help people identify a selection according to specific criteria can be considered as a decision-making tool. Another highlight in this study is to measure the helpfulness of the YouthPDA application. The main four dimensions will be evaluated to get the Cronbach's alpha values and the mean values.

II. HYBRID YOUTHPDA

The process of developing hybrid intelligent YouthPDA is using Rule-based system where its intelligence is added to the rule of construction. Selected two main theories are Multiple Intelligence (MI) and the Personality Traits (PT). Further

information regarding the construction of rule-based process is discussed in the next section.

A. Introduction of Multiple Intelligence

Each and every person has a quite high level of intelligence in one or more areas from the nine's type of Multiple Intelligence that has been clarified by Gardner (1993)'s theory. There are Linguistic, Logical-Mathematical, Musical Rhythmic, Bodily-Kinaesthetic, Spatial, Naturalist, Intrapersonal, Interpersonal and Existential Intelligence. Table I shows the explanation of each type of intelligences.

TABLE I. THE 9 TYPES OF GARDNER'S MULTIPLE INTELLIGENCE THEORY

INTELLIGENCE	DESCRIPTION
Linguistic	Finding the right words to express what you mean
Logical-mathematic	quantifying things, making hypotheses and providing them
Music	discerning sounds, their pitch, tone, rhythm, and timbre
Bodily-kinesthetic	coordinating your mind with your body
Spatial	visualing the world in 3D
Naturalist	understanding living things and reading nature
Intrapersonal	understanding yourself, what you feel, and what you want
Interpersonal	sensing people's feelings and motives
Existential	tackling the questions of why we live and why we die

The unique behaviour of each individual will classify from one person to another.

B. Personality Traits

Personality of each individual is unique that will discern their behaviours and thoughts from one to another. One of the approaches that will immerse into multiple aspects of individuals is Personality Traits. According to Cherry (2013), the reaction of individuals behaviour might be affected by trait that is a recognized characteristic. There are a few types of personality indicators that are able to measure each individual including Myer Briggs Type Indicator (MBTI) and Big Five personality traits. In particular, MBTI is used as an assessment of the personality.

Robbins and Langton (2007) categorized individuals into 16 differences personality traits group. Formerly, MBTI started with 8 indicators namely Extroverted (E), Sensing (S), Thinking (T), Judging (J), Introverted (I), Intuitive (N), Feeling (F) and Perceiving (P). The merging personality into 16 types then produce four categories of person including i) NF: valuing (manifesting universal values and valuing people), ii) SF: relating (including and building trustworthiness), iii) NT: visioning (pulling people with ideas to an optimistic future), and iv) ST: directing (action from a strategic perspective). These characteristic are able to differentiate a person with the suitable professions in the YouthPDA's recommendations.

III. DEVELOPMENT OF YOUTHPDA

YouthPDA consists of a few parts of development. The main structure is the integration of two core theories (MI and PT) that will be deliberates in this section. The other main construction involves the whole YouthPDA that occupied Rule-Based System structure.

A. Structure of hybrid YouthPDA

The integration between MI with PT contributes the hybrid intelligence in setting up the user profiling. The process flow as shown in Fig. 2 is the overall process of assimilation of both theories (Norfiza et.al, 2014).

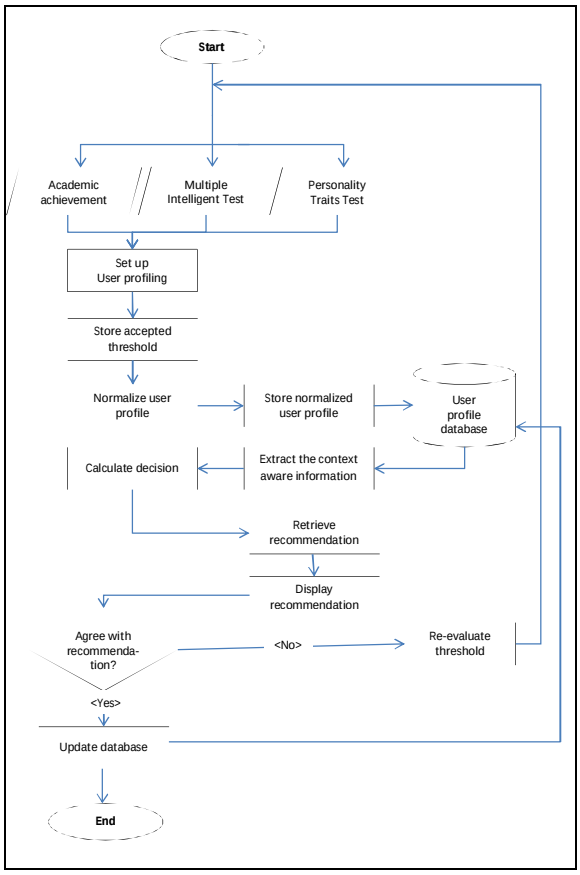

Figure 2. The process flow of Multiple Intelligence and Personality Trait integration

The YouthPDA application process flow starts with the users' input requirements which are; youth's academic achievement and their characteristic value in both Personality Traits and Multiple Intelligence tests for profiling purposes. Threshold setting should be set up prior to the user profiles that have been normalized, followed by storing in user profiles database.

Next, both of the tests result from users will be calculated precisely after the extraction of context aware information. The outputs (recommendations) will be retrieved and directly will be displayed to the users. However, the results will go through the threshold re-evaluation process if they are unable to satisfy the users and will undergo the user profiling once

again. This process generally will change the results because of some of the users insincerely reading and answering the PT and MI tests, or the aging factor that able to change the interests or habits of the users, and might affects their personality.

The results that have been generated will be updated in the database and the recommendations will be displayed to the users. In this case, the pointed out areas for YouthPDA which are study and career will notify the youth's personality type as well as their multiple intelligence level. User profiling (youth's personality and intelligence level) will be set up based on the test given, followed by recommendation results provided for youths to choose the best selection out of multiple alternatives given.

B. Hybrid YouthPDA Construction

There are many prominent artificial intelligence techniques across literature, but Rule-based System (RBS) or Rule Base Reasoning (RBR) is mostly used towards data structure knowledge based approaching to be analysed and come out with solutions (Chen, Jakeman & Norton, 2008). Two types of RBS are Forward Chaining and Backward Chaining.

YouthPDA uses RBR specifically Forward Channing Method in the development stage which applies inference that creates step-by-step logic rules for achieving appropriate solutions based on facts. This Artificial Intelligent (AI) approach, RBR consumed the "if-then" rule statement (Buchanan & Shortliffe, 1984) and the solutions are based on gathering knowledge of literature that has been formed as bunch of rules.

This technique is used since the classification made (known as the knowledge base) from set of rules as suggested from previous studies about relation between MI and PT in career and study. In other word, this type of reasoning method could classify the solutions by using those facts (MI and PT) to be integrated as new solutions as shown in Fig. 3. Forward Channing contains rule statements that create patterns for each of given solutions.

These patterns are used for inference engine to match the users input towards database as the provided solutions. In particular, the "if" statement here means "when condition is true", the "then" means "perform action A" and the "else" means "if the condition is not true take another actions". Inference engine are programs that can process those rules based on facts of a certain condition.

The YouthPDA application is developed using Netbeans software (java programming) as a desktop application. The development of this application also uses MySQL database as case base knowledge to determine the study and career results.

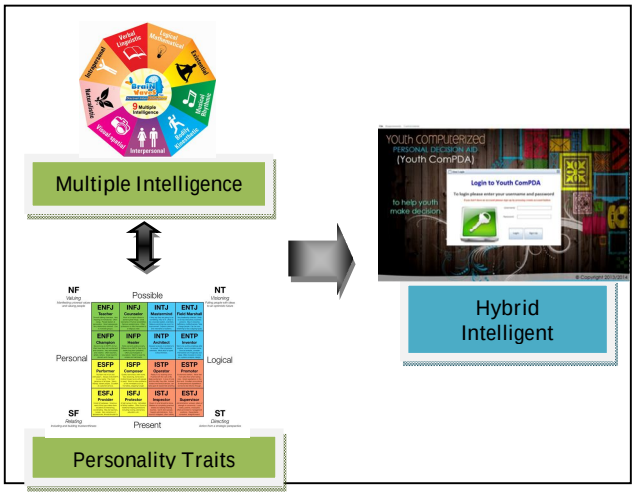

Figure 3. Hybrid Intelligent of YouthPDA's Structure

C. Context Aware Approach

The centre of attention of context aware approach in this study is on the identity that being aware through logins. The decision aid (YouthPDA) able to provide recommendations with emphasis of context aware approach by personalizing the look and feel or the personality types of the user (Fig. 1).

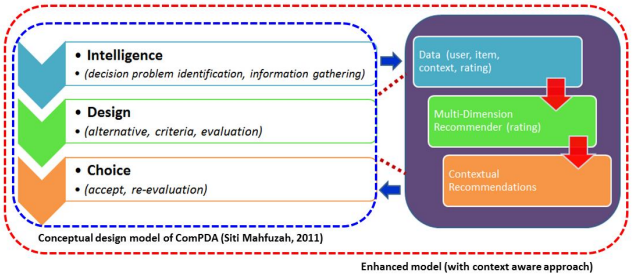

Figure 1. Context aware approach in YouthPDA

There are 3 processes involved in the YouthPDA model which are intelligence, design and choice. In brief,

i. **intelligence** process: user profiling is introduced by capturing data from multiple intelligence and personality trait questions;

ii. **design** process: the normalized user profiles together with the acceptance threshold will go through case based reasoning process before recommendation is presented to the user; and

iii. **choice** process: involve the options of either accepting or rejecting the recommendation while updating the knowledge repository with new case. The knowledge repository is also referred to in situation where recommendation is rejected or deadlock takes place.

D. Hybrid YouthPDA Application

A few main parts exist in YouthPDA interfaces including Login/Sign Up, Profile Details, Study Menu, Career Menu, PT Test, MI Test, Personality Result, Intelligence Result, Study Recommendations, Career Recommendations' page.

The process starts with login or sign up for a new user plus completing the profile details. Next, the user will choose either to acquire help on the study field (SPM results required) or career undertaking.

Meanwhile, in order to provide thoughtful and appropriate recommendations, the user's personality and intelligence level will be gained from PT and MI tests. The user is required to complete both assessments. The application shows the type of user's personality traits (Fig. 4) as well as the most prominent intelligence type (Fig. 5) before the user could identify the specified recommendations result.

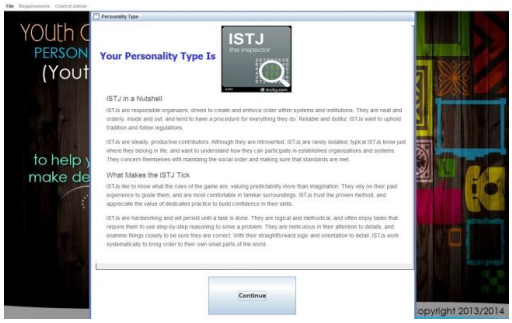

Figure 4. Personality Types Result

Figure 5. Multiple Intelligence Result

Finally, the list of the required recommendations for both study and career are displayed using tag cloud visualization model. This approach is used for an easy eye-catching and quick understanding of reading the more prominent suggestions provided by the YouthPDA. Results calculated from the decision making process for study (Fig. 6) and career (Fig. 7) are displayed using the tag clouds by providing a larger font to the suggested recommendations.

Figure 6. Result for Study Recommendations

Figure 7. Result for Career Recommendations

IV. EVALUATION

The YouthPDA application was evaluated to measure its helpfulness. The evaluation is done through survey which involves several groups of youths. The focus is on measuring the helpfulness of the YouthPDA application by using questionnaire as the main mean of data collection.

There are four main dimensions in measuring the helpfulness (Siti Mahfuzah, 2011); i) reliability, ii) decision making effort, iii) confidence, and iv) decision process awareness. The details of each dimension are shown in Fig. 8.

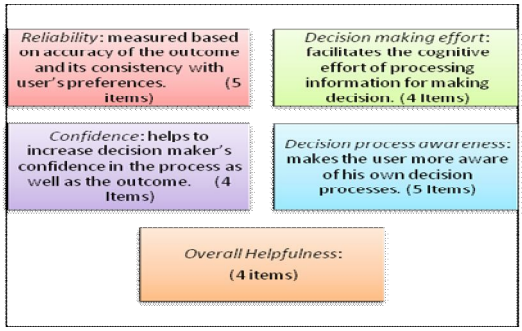

Figure 8. Dimensions of YouthPDA's Helpfulness

A. Data Analysis and Discussions

The reliability of the measurement items is tested using Cronbach's alpha, whilst the validity of the measurement items is verified using factor analysis.

TABLE II. RESULTS OF CRONBACH'S ALPHA VALUES

Factors (Dimensions)	Number of items	Cronbach's Alpha values
1) Reliability	5	0.872
2) Decision Making Effort	4	0.895
3) Confidence	4	0.908
4)Decision Process Awareness	5	0.787
5) Overall Helpfulness	4	0.883

The factor analysis was done from a sample size of 189 respondents. Table II shows the Cronbach's alpha values for all items were greater than 0.6, which indicate that all items are reliable and acceptable. The measurement items are

considered valid if the anti-image correlation matrix values are greater than 0.5 and the factors loading for each item are greater than 0.3. The results of the anti-image correlation matrix showed that almost all factors loading for each item are greater than 0.5.

The evaluation process that measures helpfulness and users' experience towards YouthPDA involves 52.4% of male respondents and 47.6% of female respondents. The measurement items used in the helpfulness evaluation of YouthPDA are based on seven-point Likert scales. Fig. 9 depicts the minimum, maximum and mean of all dimensions from the evaluation conducted.

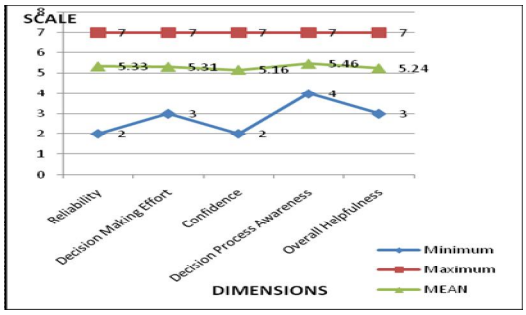

Figure 9: Data Analysis in YouthPDA's Helpfulness

The survey was carried out in two conditions; in the computer laboratory and in the open environment. Lab experiment was conducted by giving five tasks to the respondents to be completed via computers. Meanwhile, walk in surveys have also been accomplished at two venues; i) international exhibition, and ii) two schools during Sijil Pelajaran Malaysia (SPM) results released day.

As a result, the YouthPDA is accepted to be a helpful youth decision making tool as signified by the mean value for each dimension that is greater than 5.

Additionally, the percentage of youth's acceptance, which includes the intention to use the application again, conferment to the application, and time spent, towards YouthPDA application have also been evaluated. The result is as described in Fig. 10. The result shows that 96.8% of the respondents agreed and interested to use YouthPDA application again in the future. Meanwhile, 94.7% of the respondents seconded that youths should confer with YouthPDA application before making decisions. Whereas, 95.2% of the respondents agreed that YouthPDA application has shortened the time spent in making decision pertinent to study and career matters.

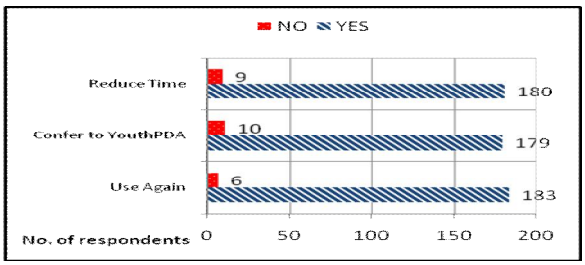

Figure 10: Youth's acceptance towards YouthPDA

The subsequent paragraphs will discuss the results of the mean values for each measurement item in the composite factors. The high mean values (i.e., greater than 5) among the items describe the strength of the system. Meanwhile the low mean values (i.e., less than 5) among the items indicate the weaknesses of the YouthPDA system that needs enhancement in the future.

Table III shows that the highest mean value among the items in Reliability dimension is 5.62, which is the item on advice provided for the decision making. Therefore, this item is perceived to be the strength for this composite factor. Whereas the lowest mean value for item under Reliability dimension is 5.33, which is the item on the suitability of decision making style, with the value of 5.33. This indicates that the item is supposed to be the weakness of this composite factor.

TABLE III. MEAN VALUES FOR ITEMS UNDER RELIABILITY DIMENSION

Items	**Mean**
1) A1 - This application can be relied to function properly.	5.60
2) A2 - This application is suitable to my style of decision making.	5.33
3) A3 - This application provides the help that I need to make a selection.	5.47
4) A4 - This application provides the advice that I require to make my decision.	5.62
5) A5 -This application is suitable even during limited time to make a decision.	5.37

The Less Effort of Using YouthPDA (Less Effort) in Table IV shows that the highest mean value is on decision process simplicity, with the value of 5.60. As a result, this item is observed to be the strength for this composite factor. The lowest mean value of Less Effort items is on easiness of decision justification interpretation, with the value of 5.40. Therefore, this item is apparently a weakness of this factor.

TABLE IV. MEAN VALUES FOR ITEMS UNDER DECISION MAKING EFFORT DIMENSION

Items	**Mean**
1) B1- The decision process in this application is logical to me.	5.46
2) B2 - The decision process in this application is simple to me.	5.60
3) B3 - I understand how decision process in this application works.	5.56
4) B4 - I found it very easy to interpret the decision justification provided by this application.	5.40

The highest mean value among the Confidence of Using YouthPDA (Confidence) items shows in Table V is on the great experience of using the application, with the value of

5.71. Hence, this item seems to be the strength for this composite factor. The lowest mean value of Confidence items is on satisfaction of recommended solution, with the value of 5.11. So, this item is perceived to be a weakness of this factor.

TABLE V. MEAN VALUES FOR ITEMS UNDER CONFIDENCE DIMENSION

Items	Mean
1) C1 - I am satisfied with the recommended solution.	5.11
2) C2 - I am confident that I am able to make selection with this application.	5.33
3) C3 - I am confident that I can justify the selection that I made with this application.	5.43
4) C4 - I am very pleased with my experience using this application.	5.71

Table VI shows that the highest mean value among the Decision Process Awareness items is on the ability of the YouthPDA to not be easily influenced by others in making selection, with the value of 5.68. So, this item is perceived to be the strength for this composite factor. The lowest mean value of Decision Process Awareness items is on decision process that shows the decision makers' subconscious, with the value of 5.42. As a result, this item is supposed to be a weakness of this factor.

TABLE VI. MEAN VALUES FOR ITEMS UNDER DECISION PROCESS AWARENESS DIMENSION

Items	Mean
1) D1 - This application makes me realize I cannot get everything from just one alternative.	5.46
2) D2 - This application shows my subconscious decision process.	5.42
3) D3 - This application helps me not to be easily influenced by others in making selection.	5.68
4) D4 - This application makes me more independent of others in making a selection.	5.53
5) D5 - I learned a lot about the problem using this application.	5.59

Meanwhile, Table VII shows that the highest mean value among the Overall Helpfulness of Using YouthPDA items is on the decision consideration, with the value of 5.58. Therefore, this item is perceived to be the strength for this composite factor. The lowest mean value of Overall Helpfulness items is on the capability to solve the decision making, with the value of 5.27. Therefore, this item is perceived to be a weakness of this factor. Though, this result is due to YouthPDA is only helping in providing recommendations and the final decision is belong to the youths themselves.

TABLE VII. MEAN VALUES ITEMS UNDER OVERALL HELPFULNESS

Items	Mean
1) E1 - This application is capable of helping me in making a choice.	5.50
2) E2 - This application allowed me to carefully consider the decision made.	5.58
3) E3 - I feel that the problem in making selection is solved.	5.27
4) E4 - This application is an aid for me in clarifying what I want.	5.41

Table VIII and Table IX show a summary of strengths and weaknesses for each composite factors of YouthPDA application.

TABLE VIII. THE STRENGTHS AND WEAKNESS OF THE YOUTHPDA

YouthPDA Factors	Strengths		Weaknesses	
	Item	*Mean*	*Item*	*Mean*
1) Reliability	A4	5.62	A2	5.33
2) Less Effort	B2	5.60	B4	5.40
3) Confidence	C4	5.71	C1	5.11
4)Decision Process Awareness	D3	5.68	C1	5.11
5) Overall Helpfulness	E2	5.58	E3	5.27

TABLE IX. THE STRENGTHS AND WEAKNESS OF THE YOUTHPDA

Strengths		Weaknesses	
A4	This application provides the advice that I require to make my decision.	A2	This application is suitable to my style of decision making.
B2	The decision process in this application is simple to me.	B4	I found it very easy to interpret the decision justification provided by this application.
C4	I am very pleased with my experience using this application.	C1	I am satisfied with the recommended solution.
D3	This application helps me not to be easily influenced by others in making selection.	D2	This application shows my subconscious decision process.
E2	This application allowed me to carefully consider the decision made.	E3	I feel that the problem in making selection is solved.

V. CONCLUSION

Development of any decision support aid will depend on the method used for the result calculation. This is because the development of decision support is not just about the use of the approaches that are able to deliver the right answer or the best

use interface to display the results, Hayes and Akhavi (2008) also said it is about the ways to effectively understand what is needed to solve human problems. YouthPDA is a personalized decision aid which is intended for youth to help them choose their study and career path using hybrid intelligence by integrating both Personality Traits and Multiple Intelligences data. The user profile functions as contextual aware rules for the reasoning to take place in the decision aid. The idea of this integration was validated through series of survey by measuring the 4 helpfulness of its application (i.e. YouthPDA). The helpfulness attributes comprise of reliability, decision making effort, confidence, and decision process awareness. The result shows the Cronbach's alpha values for all factors are reliable and acceptable. As for the mean value outcomes, all dimensions of helpfulness able to obtain greater than 5, which indicates that the decision aid is helpful for youth in making decision.

Everyone knows that every individual is unique. So as the responsible party, we need to take into account the level of personality and intelligence of each individual before they make important decisions for their future. The hybrid system applied is able to help the youths make decisions based on their interests, background and ability rather than at the behest of the family or people around. As for the future, there will be more area of interest that relevant with the current issues for the youths that should be tackled with.

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