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Career Decision Support System Using Multiple Intelligences

Tracy N. Tacuban
Iloilo Science and Technology University,
Burgos St. Lapaz Iloilo City, Philippines

Abstract

A person's success is primarily attributed to the just decisions he takes at crucial points in life, and one of these is choosing a bachelor's degree. The purpose of this study is to design and evaluate the effectiveness of Career Decision Support System Using Multiple Intelligences (CDSS-MI) in determining the dominant intelligence of the student. The general concept is for the system to determine the dominant intelligence of the student, suggest the courses that are most compatible to the student's dominant intelligence, and verify whether the personal choice of the respondent is included in the list of courses. CDSS-MI is akin to knowledge-driven DSS where knowledge elicitation from guidance counselors provided the system's knowledge base. Using Visual Basic as the development tool, the researcher chose an object-oriented approach in building the system's rule-base. The list of courses suggested by the system was validated by 281 students of the Information and Communication Technology Department of Iloilo Science and Technology University in Lapaz, Iloilo City. Majority of the respondents affirmed that the list of courses suggested by the system includes their actual preferred courses, thus, proving that the system can effectively guide the students in making a just and proper decision.

Keywords: Career Choice, Multiple Intelligences, Decision Support System

Introduction

The theory of Multiple Intelligences (MI) was first coined by Howard Gardner (1983), which stated that human intelligence is not only measured by analytical and mathematical skills but with eight bits of intelligence in varying proportions. The intelligence described by Howard Gardner includes Linguistic, Analytical/Mathematical, Visual/Spatial, Interpersonal, Intrapersonal, Bodily Kinesthetic, Musical, and Naturalist (Armstrong, 2009).

According to Hopper (2014), Linguistic intelligence includes both verbal and writing skills using languages. These include using words and playing with the verbal structure or a use of clues to remember things. Logical-mathematical intelligence includes the ability to determine the reason, cause and follow the logic order. Spatial intelligence, on the other hand, includes the use of images and visuals to represent information. Musical intelligence includes the use of rhythm, melodies and learns through the use of varied sounds and music. Bodily-kinesthetic intelligence includes acting out, doing, and performing an activity to learn the skills. Interpersonal intelligence includes good relationship and understanding of other people. Intrapersonal intelligence means understanding and appreciating one's true and inner self. Naturalist intelligence includes love and appreciation of nature.

his study was anchored from the research conducted by Pabalinas *et al.* (2015). In the study, it was found out that the students' inclination to multiple intelligence has significant relationship to their career choice.

Moreover, this study was anchored from the research conducted by Shearer and Luzzo (2009). According to the research findings, Multiple Intelligences can be used in Career Counseling. Hence, MI can be easily understood by both the counselee and their family members. MI provides an alternative

*Correspondence: tracy_sem22@yahoo.com

and an expanded range of career possibilities that the students can consider rather than just measuring his/her intelligence based on mathematical and linguistic examinations.

These finding show that the theory of Multiple Intelligences can support and help Guidance Counselors address issues encountered by students in choosing their college courses by grouping students whose dominant intelligences are suited in a particular college course. If students are given career guidance based on their interest and abilities, these students have a definite chance to succeed in their college courses as compared to those who haven't received any career guidance.

Johnston (1998) stated in a research conducted in Sheffield Hallam University that most respondents who leave their tertiary education noted three (3) distinct reasons. These reasons as stated by the respondents include 1. they do not like the course at all finding it unsuitable, 2. personal reasons, and 3. academic problems.

The problems in the dropout rate and failing grades in College can be minimized if students taking up a certain course were guided before enrolling the course. This means assessing their intelligences and capabilities in order to determine the most appropriate courses to take.

In a research conducted by Aslam and Khan (2011), a rule-based decision support system was developed to guide students select a suitable faculty or college major based on their abilities and capabilities. The study used the student's past academic record, intelligence test results, and abilities test results to guide students in choosing their major subjects they should enroll.

Zwibelman and Plant (1994), also developed a Decision Support System that could assist clients to decide on their career goals by determining first their personality type based on Holland's Categorization and provide feasible college majors based on the client's personality type.

Career Decision Support System Using Multiple Intelligences is anchored on the theory of multiple intelligences. It determines the dominant intelligence of the student and suggests the list of courses that are suited to the student's type of intelligence. It is a web-based Knowledge-Driven Decision Support System (KD-DSS) making it easily accessible to end-users.

According to Power (2002), DSS is an interactive computer-based system or subsystem intended to help decision-makers use communications technologies, data, documents, knowledge, and/or models to identify and solve problems, complete decision process tasks, and make decisions. In general, decision support systems are a class of computerized information system that supports decision-making activities.

Knowledge-Driven Decision Support Systems store and apply knowledge for a variety of specific business problems. It suggests or recommends actions to targeted users. This type of DSS has specialized problem-solving expertise relevant to a specific narrow task. The "expertise" consists of knowledge about a particular problem domain, understanding of problems within that domain, and "skill" at solving one or some of these problems.

Usually, the knowledge component of the system comes from the domain expert or the person who has expertise in the domain in which a specific system is being developed. A domain expert works closely with a knowledge engineer to capture the expert's knowledge in a knowledge base. Knowledge acquisition is the process of extraction and formulation of the knowledge from the expert. The knowledge obtained forms the system's knowledge base or the collection of organized facts, rules, and procedures. Because the system attempts to simulate the human reasoning processes, these types of systems is akin to expert systems.

Materials and Methods

Career Decision Support System used the Software Development and Descriptive Research Method.

The study includes the design and utilization of a Career Decision Support System to assess the suitable courses of its users based on his/her dominant Multiple Intelligence. The researcher used the Spiral Model in the design of the system. According to Pressman (2010), the Spiral model was coined by Barry Boehm. It combines the processes used in waterfall model and prototyping. The iterative process of the Spiral model is done using the prototyping process and is controlled by the systematic approach used in the Waterfall Model. The system using Spiral Model is continuously developed and released after the completion of an improved prototype.

Moreover, a Descriptive Research Method was used to gather data to evaluate the system's output as perceived by the respondents. Descriptive Research Method was further used to organize and tabulate the data collected from the survey so as to determine whether the system displays the preferred courses of the respondents, thus proving the validity of the system to assess the interest of the respondents and determines their preferred courses.

The system closely resembles a Knowledge-driven DSS (KD-DSS). According to Power, a knowledge-driven DSS suggests or recommends actions to targeted users. This type of DSS has specialized problem-solving expertise relevant to a specific narrow task.

However, the system departs from the general concept of KD-DSS as being interactive due to the fact that it is web-based.

Web-based applications uses Hypertext Transmission Protocol (HTTP) which is inherently stateless and the concept of DSS as interactive wouldn't apply. When a Web server receives a request for a page from the client, it finds the page, processes it ang probably save some data, sends its respond to the browser, and then discards all page information. If the user requests the same page again, the server repeats the entire sequence, reprocessing the page from scratch. Put another way, a server has no memory of pages that it has processed. Only when the application has all the needed data shall the application start processing with the purpose of evaluating the user's intelligence and provides the suggested list of courses.

The Career Decision Support System using Multiple Intelligence was designed according to the development model created by Zwibelman and Plant (1994) as a design for developing Decision Support System.

A. Knowledge Elicitation

The researcher conducted a series of interviews with Guidance Counselors and experts in Counseling and came up with the list of questions to conduct a multiple intelligence test and the list of courses. Both the list of questions and courses are individually mapped to the intelligence categories the researcher likewise determines how the domain expert would conduct the multiple intelligence test. Based on the test result, the researcher inquired with the domain experts how to generate the appropriate list of courses. The information gathered was used to build the knowledge base.

The list of courses and questions were later stored in Microsoft SQL Server 2005 Express Edition observing the rules of normalization and referential integrity so the items points to their respective intelligence categories for proper access.

B. Knowledge Representation.

The system is designed using Microsoft Visual Studio 2005 with Microsoft Visual Basic as the programming language. The researcher took an object-oriented approach in building the system's knowledge base as the rule-base of the system is inherently by the chosen

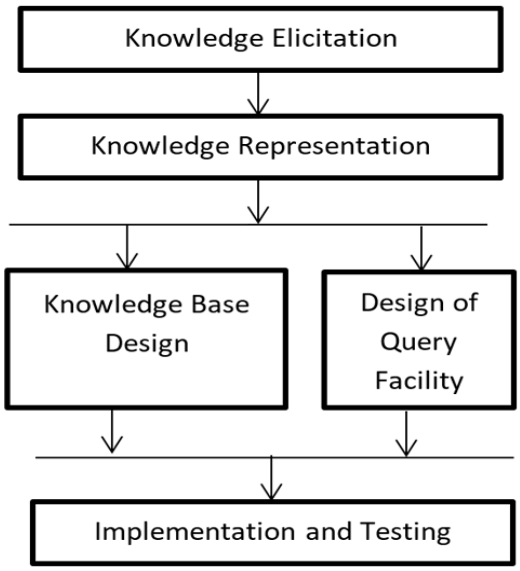

Figure 1: *Development model of DSS*

language.

The knowledge base contains the relevant knowledge of an expert in solving the problem. It primarily consists of a set of rules in the form of "If Condition Then Action" which forms the basis of how an expert would solve the problem. With Visual Basic's control structure, the IF-THEN statement is an inherent framework in constructing the rule-base. Ultimately, the system's rule-base is implemented as classes with the rule-base contained in a procedure to be invoked by the inference engine. .03 cm, respectively.

C. The Query Facility

The Query Facility or the Inference Engine is used to obtain the input from the user and query the knowledge base for the appropriate response. The user's inputs are the answers to the survey questions that were posted to the user. The inference engine is implemented as an abstract class which instantiates its rule-base and monitors for an event raised by the rule-base with the event data containing the rule-base's response to the query.

In order to determine the dominant intelligence and the list of courses suited to the respondent, forty (40) questions on human behavior were equally divided into eight categories of Multiple Intelligences are submitted to the student for response. The lists of survey questions were validated by the domain experts (guidance counselors) as appropriate in the conduct of a multiple intelligence test. The respondent needs only to select from four possible choices whether the question best describes them or not.

The survey questions were divided four (4) web forms for the respondent to fill out. Based on the responses, the inference engine determines the overall score of the student in each of the multiple intelligence categories using the rule-base.

The four possible choices are built on the principle of fuzzy logic and include: Not At All True Of Me, Slightly True Of Me, Mostly True Of Me and Very True Of Me. Each choice has a corresponding scale representing the degree of fuzziness

As stated in tutorialspoint.com, (2016) Fuzzy Logic was developed by Lotfi Zadeh who observed that human decisions are likely to include several possibilities rather than just mere Yes or No such as Certainly Yes, Possibly Yes, Cannot Say, Possibly No, Certainly No.

Fuzzy logic uses a set of rules known as IF-THEN-ELSE control structures that are stated as:

IF condition then
{*statement*}
Else IF condition
{*statement*}
Else
{*statement*}

In the paradigm of Visual Basic programming, the concept of fuzzy logic has a direct implementation, using the IF-THEN-ELSE statement and the very narrow task of how the domain expert would solve the problem requires no complex algorithms.

To determine the total score of the student in each of the multiple intelligence categories, the rule-base is constructed like this:

If Category of Question = Linguistic and

Answer = Not At All True Of Me Then

Add the Not At All True Of Me Scale to the Total Score for Linguistic

Else If Category of Question = Linguistic and Answer = Slightly True of Me Then

Add the Slightly True of Me Scale to the Total Score for Linguistic

Else If Category of Question = Linguistic and Answer = Mostly True of Me Then

Add the Mostly True Of Me Scale to the Total Score for Linguistic

Else If Category Of Question = Linguistic and Answer = Very True of Me Then

Add the Very True Of Me Scale to the Total Score For Linguistic. . . .

In order to execute the above rule-base, the inference engine would instantiate the rule-base class and read its database of the respondent's answer to every survey question. The inference engine passes the value for the Category of Question and the Answer to the rule-base for execution. The inference engine would repeatedly perform the task for each survey answer to get the total score of the user in each of the multiple intelligence categories.

Forward chaining is inherently implemented in IF-THEN-ELSE statement and the rule-base stops where the IF clause is known to be TRUE. It terminates the search process by returning the data in the THEN clause as an event data to the inference engine for storage.

The inference engine could then instantiate a separate class to containing the rule-base to determine the highest computed score of the respondent.

Based on the highest score, the inference engine determines the multiple intelligence category of the highest score and instantiates a separate class to generate the list of courses and pass the category type of the respondent's dominant intelligence. The newly created object queries the database for the list of courses that are suited for that specific intelligence category. The inference engine will then display the dominant intelligence of the respondent together with the suggested list of courses which forms the decision-making support of the system to the student.

Part of the feature of the query facility is to provide the justification of the system's output. The inference engine would read the total score of the respondent by intelligence category and sort the scores in descending order. It then instantiate its rule-base and pass the total score for each category to form the system's justification. The rule-base is built using the following rules

If Intelligence Category = Linguistic Then

Message = "You have {total score} linguistic intelligence.

Else if Intelligence Category = Logical Then

Message = "You have {total score} logical/mathematical intelligence.

Else If Intelligence Category = Spatial Then

Message = "You have {total score} spatial intelligence

Else If Intelligence Category = Bodily-Kinesthetic Then

Message = "You have {total score} bodily-kinesthetic intelligence

Else If Intelligence Category = Musical Then

Message = "You have {total score} musical intelligence

Else If Intelligence Category = Interpersonal Then

Message = "You have {total score} interpersonal intelligence

Else If Intelligence Category = Intrapersonal Then

Message = "You have {total score} intrapersonal intelligence

Else If Intelligence Category = Naturalist Then

Message = "You have {total score} naturalist intelligence

End If

Using the rule-base, the query facility will then display the total score of the respondent in each of the multiple intelligence categories in descending order with the highest score representing the respondent's dominant intelligence.

To evaluate the system/s output and test whether the result of the system can provide

valuable decision-making support to users on what course to take in college, black box testing was conducted.Black box testing is a technique to determine the functionality of the system without peering into the system's internal logic. (Pressman, 2010)

To conduct the black box test, a group of respondents were asked to fill out a questionnaire whether the system displayed their preferred courses or not from the list of suggested courses after taking a Multiple Intelligence test.

If the result of the evaluation indicates that majority of the respondents agree with the output of the system, the researcher can conclude that the system functions accordingly and can give valuable advice to students because it was able to determine the dominant intelligence of the student and list the preferred course of the student.

Evaluation and Respondents of the Study

In determining the number of respondents to evaluate the suggested list of courses provided by the system, the researcher used Slovin's formula.

Slovin's formula according to Ellen, Stephanie (n.d) is one of the easiest sampling techniques used to determine the sample size of each subset based on the entire population.

Adapting the formula, the researcher determines how large the sample size of the study is. The sample size for each subset is calculated using the formula:

$$n = N/(1 + Ne^2) \quad (1)$$

where n = Number of samples, N = Total population and e = Error of tolerance.

The researcher used the value .05 as the error of tolerance. Thus, to calculate the sample size of the study, the researcher substituted the following known data: N=941 and e=0.05.

$$n = \frac{941}{(1 + 941 * 0.05^2)} = 282$$

The evaluation of the system was tested at Iloilo Science and Technology University by 282 Information and Communication Technology (ICT) students taking up Bachelor of Science in Information Technology, Bachelor of Science in Information Systems and Bachelor of Science in Computer Science under the Computer Department.

Using proportionate sampling, the researchers divided the entire population of 941 Computer Department students into 281 respondents. The Bachelor of Science in Information Technology (BSIT) has a total population of 541 students. Using Proportionate sampling, the sample size taken from BSIT was 163 respondents. The Bachelor of Science in Information Systems (BSIS) has 173 students and the researcher came up with 52 BSIS respondents. The Bachelor of Science in Computer Science (BSCS) has 227 students. Using proportionate sampling, the researcher gathered 67 BSCS respondents.

The respondents per course were divided per section so as to determine the sample size taken in every section.

Data Processing and Statistical Treatment

Microsoft Excel 2007 was used in processing the statistical data pertaining to the total number and ratio of respondents who affirmed that the system reflects their preferred courses compared to those who disagreed.

IBM SPSS was used to calculate the Chi Square value of the data collected to determine the acceptability of the system's output as perceived by the respondents.

According to McHugh (2013), Chi-Square Test is a used to analyze differences between groups of data which are measure at nominal level. Chi-Square does not require equality of variance between the groups and permits the evaluation of independent variables.

Using Chi Square, the researcher tried to find out whether there is a difference between the number of respondents who answered that the system reflects their preferred courses and those who answered that the system did not

Table 1: *Responses from Bachelor of Science in Information Technology*

Student's Responses on whether the system displays their preferred course.	Freshmen		Sophomore		Junior		Senior		Total	
	F	*%*	*F*	*%*	*F*	*%*	*F*	*%*	F	*%*
No. of Respondents who answered YES	40	70.18	30	61.22	19	63.33	19	70.37	108	66.26
No. of Respondents who answered NO	17	29.82	19	38.78	11	36.67	8	29.63	55	33.74
Total	**57**	**100%**	**49**	**100%**	**30**	**100%**	**27**	**100%**	**163**	**100%**

reflect their preferred courses.

Results and Discussion

The purpose of this study is to establish the correlation between the suggested lists of courses of the system with the preferred courses of the respondents to establish the system's validity.

After the respondent fills out the survey form, the system determines the dominant intelligence of the respondent and suggests the courses that the respondent should take in college. The system provides a justification on the list of courses being suggested. The list of courses and the system's justification forms the basis of the respondent's decision-making process in choosing the appropriate degree program.

For Bachelor of Science in Information Technology (BSIT), the total sample size for the respondent is 163. Table 1 shows the breakdown by year and section and the number of respondents who answered that the system displayed their preferred course and those who answered that the system did not display their preferred course.

Based on the tabulated data, 108 out of 162 BSIT respondents or 66.26% of the population answered that they have seen their preferred course among the list of courses generated by the system and 55 respondents or 33.95% of the respondents answered that the list of courses generated by the system did not display their preferred course.

This implies that majority of the respondents agree with the list of courses being suggested by the system, that the system was able to determine their most dominant intelligence. It implies further that the system is an effective tool in making an appropriate decision in choosing a college degree.

This result was supported by the study conducted by Pabalinas, Teves, Teves (2015) showing that the intellectual inclinations of a person based on multiple intelligence influence their .career choice. It implies that whatever the dominant intelligence of the student, his choice of college program will be on courses that are appropriate to his dominant intelligence.

Table 2 shows the responses taken from Bachelor of Science in Computer Science (BSCS) with 67 respondents.

Based on the data presented, 53 out of 67 or 79.10% of BSCS students answered that their preferred course was displayed by the system and 14 or 20.90% of the respondents answered that their preferred course was not displayed by the system.

This implies that for the BSCS respondents, majority of the respondents agree with the list of courses being suggested by the system and is an effective tool in making an informed decision in choosing a course. It further indicates that the intellectual inclinations of a person based on multiple intelligence influence their career

Table 2: *Responses from Bachelor of Science in Computer Science*

Student's Responses on whether the system displays their preferred course.	Freshmen		Sophomore		Junior		Senior		Total	
	F	*%*	*F*	*%*	*F*	*%*	*F*	*%*	F	*%*
No. of Respondents who answered YES	18	75	19	86.36	10	100	6	54.55	53	79.1
No. of Respondents who answered NO	6	25	3	13.64	0	0	5	5	14	20.9
Total	**24**	**100%**	**22**	**100%**	**10**	**100%**	**11**	**100%**	**67**	**100%**

Table 3: *Responses from Bachelor of Science in Information Systems*

Student's Responses on whether the system displays their preferred course.	Freshmen		Sophomore		Junior		Senior		Total	
	F	*%*	*F*	*%*	*F*	*%*	*F*	*%*	F	*%*
No. of Respondents who answered YES	12	92.31	10	83.33	10	76.92	11	78.57	43	82.69
No. of Respondents who answered NO	1	7.692	2	16.67	3	23.08	3	21.43	9	17.31
Total	**13**	**100%**	**12**	**100%**	**13**	**100%**	**14**	**100%**	**52**	**100%**

choice.

Table 3 shows the tabulated data gathered from Bachelor of Science in Information System (BSIS) students. The total number of respondents is 52 and is proportionally divided among each section.

Based on the data presented, 43 or 82.69% of the respondents from BSIS answered that their preferred course was displayed by the system and only 9 of the respondents or 17.31% answered that the system did not display their preferred course.

This implies that for the majority of BSIS respondents, the list of courses suggested by the system in the decision process of choosing the appropriate degree program The result support the claims of Shearer and Luzzo (2009), that careful analysis of the client's strengths and weaknesses in Multiple Intelligence can help counselors guide students with the specific career path based on their skills and interest. Table 4 presents the summary of the tabulated data from the overall respondents. The data shows that 204 or 72% of the total respondents answered that the system displayed their preferred course while 78 or 28% of the respondents answered that the system failed to display their preferred courses. The majority of the respondents affirmed that the system is able to include their preferred course from the suggested list of courses. It implies that the system is an effective tool in guiding the students in the decision process of selecting the suitable course for college.

These results strongly supported the claim of Shearer and Luzzo (2009) that Multiple Intelligence can be used to provide realistic career possibilities to the counselee and the student.

Using Chi Square Test, Table 5 shows the tabulated number of respondents who

Table 4: *Total Responses from all Courses*

Student's Responses	BSIF		BSCS		BSIS		Total	
	F	*%*	*F*	*%*	*F*	*%*	F	*%*
No. of Respondents who answered YES	108	66.26	53	79.1	43	82.69	204	72.34
No. of Respondents who answered NO	55	33.74	14	20.9	9	17.31	78	27.66
Total	**163**	**100%**	**67**	**100%**	**52**	**100%**	**282**	**100%**

Table 5: *The Chi-Square Test of the Data from all Respondents*

Variables	**Significant Difference**	
Student's Responses	Person's Chi square	0.199
	Likelihood Ratio	0.159

answered that their preferred course was displayed by the system and the number of respondents who answered that their preferred course was not displayed by the system.

The result of the Chi Square Test shown in Table 5 depicts that the Pearson Chi Square value of 0.199 is greater than the significance level 0.05. This means that there is a significant difference between the numbers of respondents who answered that the system displayed their preferred course as compared to the number of respondents who answered that their preferred course was not displayed by the system.

The association of the responses is weak. Therefore, the result shows that the evaluation of the system's output as perceived by the respondents greatly differ from each other.

It implies that the system is able to effectively suggest to the respondent the suitable course for college. The result supports the claim of Balogun and Thompson (2009) that DSS, when designed properly, can be used to help the students choose their career path similar to an advice that is given by Guidance Counselors.

Conclusion and Recommendations

The application of decision support system guides the decision maker to make the most appropriate action. Based on the results presented, the Career Decision Support System has a high probability of suggesting the compatible degree program to the student making it an invaluable tool in decision making, particularly in choosing the most appropriate baccalaureate program matching their interest. While there is an insignificant number of respondents who disagree with the system's output, it is also noteworthy to indicate that the list of courses in the system's database are the courses being offered only at Iloilo Science and Technology University. If all the offered courses in higher education have been included, the number of respondents who disagreed with the system may have been reduced farther.

The researcher proposes that the system be used by the Guidance and Testing Office as well as the students in selecting the appropriate degree in college that is attuned to their interest. It is recommended that the system should be implemented to assess students before enrolment, not to replace the old system or processes but as an additional tool to guide students.

Moreover, the researcher would like to recommend that the system should be expanded to include all the possible courses that may be offered in tertiary education so as to allow the student to have a wider range of choices. Supplementary features may also be included like personal information of the student like family income, home town, scholarship grants, and others so as to advice the student further on the degree to take appropriate with their economic and social background.

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