AMERICAN UNIVERSITY OF BEIRUT

APPLICATION OF THE ANALYTIC HIERARCHY PROCESS TO STUDENT DECISION MAKING: A STUDY OF HOW MASTER OF SCIENCE IN NURSING STUDENTS CHOOSE TOPICS FOR CAPSTONE PROJECTS

by
EVA TABARANI

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ACKNOWLEDGMENTS

I would like to thank Dr. Michael Clinton for his guidance and continuous support throughout my project. I am grateful for the time he spent helping me to choose my research topic. His patience and feedback throughout the project period is gratefully acknowledged.

I also wish to thank Dr. Lina Younan for her help and guidance in completing this project. She undoubtedly was a driving force behind this project, providing me with much support and encouragement.

I deeply thank my family for their continuous support throughout this tough period and for being there for me when I most needed.

ABSTRACT OF THE PROJECT OF

Eva Tabarani for Master of Science
Major: Nursing Administration

Title: Application of the Analytic Hierarchy Process to Student Decision Making: A Study of How Master of Science in Nursing Students Choose Topics for Capstone Projects

The purpose of this study was twofold: to determine whether Master of Science in Nursing (MSN) students find the AHP process helpful when choosing the topic for their three credit point capstone project; and to test the utility of an open source software package for conducting AHP (the Business Performance Management Singapore AHP Online System). Four students participated in the AHP process. All four students found the process helpful when choosing a project topic. One of the participants qualified this by stating only if the student was unsure about the choice of topic.

The BPMSG was easy to use and resulted in individual and group decision making hierarchies. All four students thought that the AHP process would be useful for other students because it helps to recognize personal interests and priorities and to organize ideas. "Relevance to my current job" was found to be the top priority when deciding on project topic, followed by "relevance to my future career".

In descending order of importance other influences on selection of project topic are: "Interest in the study population"; and "Help me to get a better job". Neither the workload involved in completing the study nor the ease of writing up the results was a major influence on choice of project topic. Overall the findings of the study suggest that the AHP process may assist MSN students to prioritize potential topics when deciding on a focus for their capstone projects and that the BPMSG AHP Online System is suitable software for the analysis of AHP decision making processes; although some students will require assistance to use the software. It should be noted that the study was limited by the small sample size.

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CHAPTER ONE

BACKGROUND

A. Introduction

Decision making is important to humans in order to satisfy their needs and meet their goals. Several considerations must be made when making a decision. These considerations include the benefits derived from making the right decision as well as the costs, the risk and losses resulting from actions or non-actions taken if the wrong decision was made (Alexander, 2012).

Masters in nursing students may be undecided about what project topic to work on for their capstone project. They are sometimes lost and hesitant about where to start from. They may feel overwhelmed, and when they are, they may be unable to think through the different options they have.

Students puzzled by selecting a topic for their capstone project might find it helpful to use a decision making method. Decision making methods range from reliance on chance to the use of more structured tools. A sound decision involves weighing all important factors against competing priorities in order for the right choice to be made though nothing is guaranteed. One of the modern tools developed in the last thirty years used to assess, prioritize, rank and evaluate decision choices is the Analytic Hierarchy Process.

The Analytic Hierarchy Process (AHP) is a multi-criteria decision-making approach introduced by Professor Thomas Saaty in 1977.The AHP is a helpful support tool for decision making and can be used to solve complex decision problems

(Triantaphyllou & Mann, 1995). AHP is used globally in a wide range of fields such as government, business industry, healthcare, and education. The AHP uses a multi-level hierarchical structure of goals, criteria, sub-criteria, and alternatives to assist decision makers in evaluating options. Pairwise comparisons are used to identify the relative priority of decision criteria and alternatives which are then expressed as ratio scales or weightings. The AHP can also assist the decision maker to resolve any identified inconsistencies between the decision criteria and the alternatives.

An example on the use of the AHP: A nurse may find it difficult to choose between following a career in adult care or a career in community nursing. The decision criteria she may take into account are personal interest in the area of practice, convenience of working hours, availability of time off weekends, opportunities to work with under-privileged groups. After conducting pairwise comparison of these decision criteria and applying the resulting weights to the alternative career choices, she gives a priority to community nursing of 65% compared to adult nursing (35%).

AHP can be used to make decision making processes transparent and consistent. There is no requirement that the decision maker accept the result, only that the decision maker takes the results of the analysis into account when making the decision. AHP is an aid to rather than a substitute for human decision making processes (Triantaphyllou & Mann, 1995).

This project has two objectives, to:

1. Determine whether Master of Science in Nursing (MSN) students find the AHP process helpful when choosing the topic for their three credit point capstone project.
2. Test the utility of an open source software package for conducting AHP (http://bpmsg.com/academic/ahp.php)

CHAPTER TWO

LITERATURE REVIEW

Literature review shows many applications of the Analytic Hierarchy Process (AHP). AHP has been used in professional planning, in education, in manufacturing technology, in strategic planning, option appraisal, in healthcare and healthcare administration, NASA in choosing the Lunar Lander propulsion system, in designing automobiles, in the selection of electric equipment on submarines, in ranking streams in interior Alaska for sustaining an introduced Rainbow trout population, in resource allocation (Forman & Gass, 2001). This paper sheds light on the use of the AHP in students' decision making specifically in selecting their project topic. These students may find difficulty in deciding for their capstone project. They might consider some criteria for their selection and still face doubt in deciding.

While a study on the selection of student topics for their capstone project has not been addressed in the literature, other studies on the application of the AHP in student selection exist in the literature to name a few students' selection of university majors, students' selection of a university, students' selection of a doctoral dissertation professor.

To help students select a university major, a model was developed by Strasser et al. (2002) that applied the AHP for the selection of majors among college students. The model was based on three criteria: subject, influence from others and career. A second study by Hayrapetyan (2012) who developed a decision-making support system named as "May I help you?" that applied the AHP. The aim was to assist students in selecting

their college majors based on three common criteria: compensation, job availability and growth as well as the influence of others.

To assist students select a university, Tas and Ergin (2012) applied the AHP to identify the criteria employed by Turkish students for selecting universities in the USA to pursue their Master's degree. Twelve criteria were prioritized using the AHP and it was pointed out that students placed much importance on career prospects and job opportunities when selecting universities in the USA.

Another study on students' selection of a university by Jayakumar et al. (2010) identified five most popular criteria highlighted by parents and students in their selection of engineering colleges in Tamil Nadu, India. The criteria were location, job placements, teaching faculty, infrastructure and costs. These criteria were then ranked using the AHP.

Moreover, another study by Wang (2007) on medical students' selection for specialties. A survey at a medical school in northern Taiwan analyzed senior medical students' preferences in specialty choice. Results showed that "Personal intelligence and/or ability preference" was the most important factor, while the economic factors, such as future income, were ranked lower. The AHP was found to be helpful in the students' selection for specialties.

Another study on doctoral students' selection for their thesis supervisor selection was based on a set of criteria. Those criteria were derived from a survey of doctoral students' opinion of the most important criteria that must be considered in the selection of a research guide and then modeled as an AHP problem. The AHP technique showed to add value to students' judgment by introducing objectivity and quantification of priorities, providing students with a more informed option of supervisor (Ray, 2007).

In addition to education, the AHP has been applied in a number of studies in medicine, nursing and healthcare administration:

A. Medicine

In medicine, a study was conducted about selecting the best diagnostic management for patients with upper gastrointestinal bleed taking into account patient/physician preferences. Dr James Dolan, Dr Donald Bordley and Dr Heidi Miller (2001) of the University of Rochester School of Medicine in Rochester, New York who used the AHP to determine whether endoscopy should be routinely ordered to establish the source of the bleeding. This has been an expensive test and physicians needed to make the decision whether this test was worth ordering routinely. Results showed that 92 % of patients' cases preferred immediate endoscopy compared to 55% of the physicians. Upon evaluating the objectives, patients ranked "identifying the cause of bleeding" the second most important after "avoiding a poor outcome from the acute bleeding episode". This example underlines the importance of the use of the AHP in making decisions about managing a clinical condition (Forman & Gass, 2001).

B. Nursing

The AHP has been also applied in nursing. A recent study by Frank Pan (2014) on selecting the factors that mostly attribute to nurses' stress. A modified Analytic Hierarchy Model was adopted. 105 nurses from several randomly selected hospitals in southern Taiwan were investigated to generate factors. Ten experienced practitioners were included as the expert in the AHP to produce weights of each criterion. Six nurses from two regional hospitals were then selected to test the model. The study result

showed that the family factor was the most important factor, followed by the personal attributes. Top three sub-criteria that attribute to the nurse's stress-coping capability were children's education, good career plan, and healthy family. The practical simulation provided evidence for the usefulness of this model in helping the practioners identify the different factors that contributed to the nurses' stress.

C. Healthcare Administration

A study of a nursing department performance measurement system using the balanced scorecard and the AHP was formally implemented in January 2003 in a hospital affiliated with a national university in Taiwan in order to improve performance in terms of quality of care and financial efficiency. It was the first study that provides a balanced scorecard-based incentive plan. The AHP was used to determine the relative weights of the performance measures. Those measures included "patient satisfaction rate, blood preparation error rate, the use of two methods to identify patients before lab work and treatment, patient visitor complaint rate, and the number of unachieved continuous training hours per person" (Chu et al., 2009). In addition to determining the relative weights of the previously mentioned performance measures, the AHP was also used to assess the appropriateness of the current weights in the nursing department balanced scorecard- based incentive plan. The nursing department's performance improved in the two years following the introduction of the plan. The findings showed that patient satisfaction was considered to be the most important criteria for measuring performance. The AHP was considered to be an effective method for determining the relative weights of the performance measures in the balanced scorecard (Chu et al., 2009).

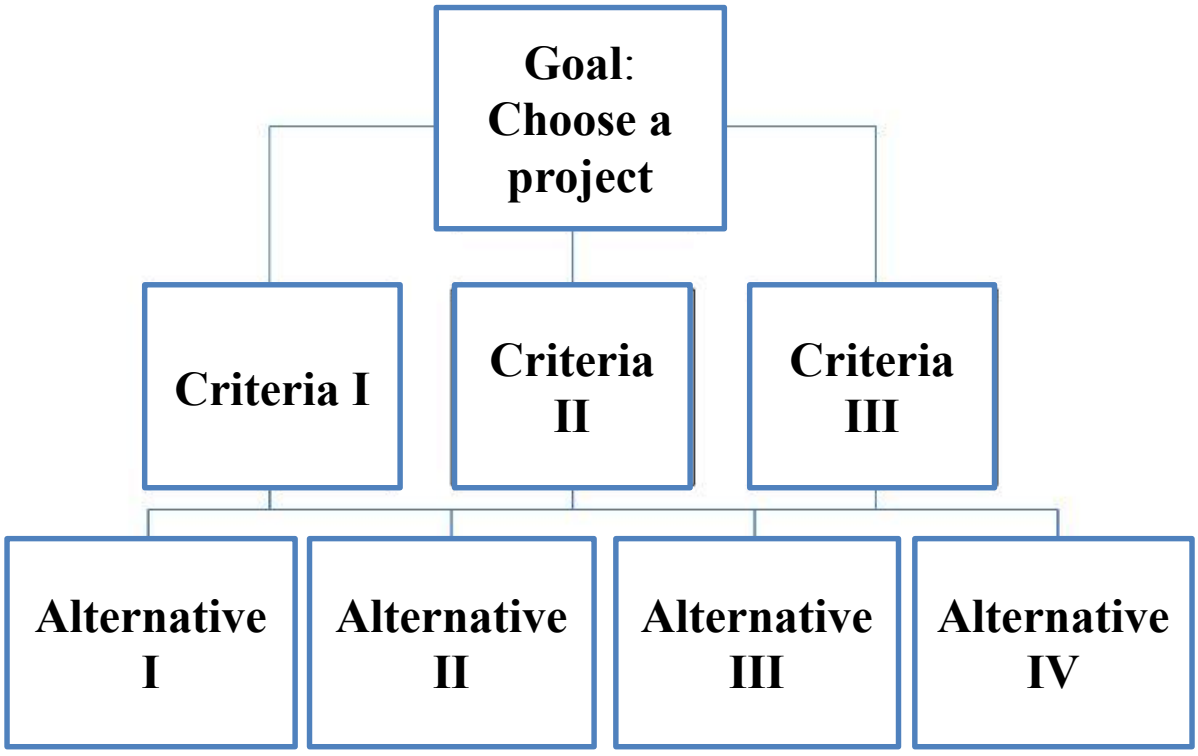
The above literature indicates the relative importance of the AHP in topics related to students' selection of majors and universities, physicians' selection of the best medical management for patients with upper GI bleed, nurses' selection of the factors that contribute to the nurses' stress-coping capabilities and hospital administration's selection of the main performance indicators of a department's balanced score card.

CHAPTER THREE

AHP FRAMEWORK AND PROCESS

The steps in the AHP process described below (p.9) can be represented in a diagram that shows the application of the method to the selection of capstone project topics by MSN students.

Figure 3.1. Diagrammatic representation of the AHP process applied to the selection of a capstone project topic by an MSN student.



CHAPTER FOUR

STUDY DESIGN

The Analytic Hierarchy Process starts by determining the pertinent factors to the decision making at hand, and then assists the decision maker (individual or group) to organize them into a hierarchy of decision criteria. This hierarchy breaks down an overall objective into successive levels of decision criteria with numerical weights assigned to each variable (Saaty, 1990). The detailed steps in the AHP as explained by Saaty (2008) are as follows (As cited in Anis &Islam, 2015)

Step 1. Define the goal of the problem.

Step 2. Structure the decision hierarchy with the goal of the problem from the top, through the intermediate levels (criteria and sub-criteria) to the lowest level (usually the set of competing decision outcomes).

Step 3. Construct pairwise comparison matrices. Each element at an upper level is used to compare the elements in the level immediately below it. In pairwise comparison matrices, a scale of 1–9 is utilized to explain the extent to which one element is dominant over another with respect to the criterion used for comparison. The overall priority of elements is obtained and applied to prioritizing the set of decision outcomes. A detailed pairwise comparison scale is displayed below.

Table 1.1. Pairwise comparison scale

Intensity of Importance	Definitions	Explanations
1	Equal importance	Two activities contribute equally to the objectives
2	Weak or slight	
3	Weak importance of one over another	Experience and judgement slightly favor one activity over another
4	Moderate plus	
5	Essentials or strong importance	Experience and judgement strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is very strongly favored over another. Its dominance is demonstrated in practice
8	Very, very strong	
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation

Source: Saaty (2008)

A. Ratio Scales and Consistency Index

In AHP, ratio scales and consistency index are derived respectively from mathematical methods called Eigen vectors and Eigen values. A key aspect in the AHP process is consistency check on the judgment. Perfect consistency rarely occurs in practice. There is a possibility that the participants make inconsistent judgments when completing the pairwise comparison process. An example on checking consistency might be if two criteria are equally important then they should maintain identical ratios with other criteria. When this does not occur, inconsistencies in judgments are clear. Saaty (1980) suggested that these inconsistencies are tolerable if they are of a lower magnitude (10%) than the actual measurements.

The study was designed as a computer assisted exercise in individual decision making using the BPMSG AHP Online System.

B. Setting and sample

1. Sample

The sample consisted of four participitants who were Master of Science in Nursing students in different tracks: Adult care, Administration, Psychiatry and Community recruited from among students planning to complete their three credit capstone projects in spring 2015. Students were required to consult with their advisers (the faculty members who will oversee their projects) early in the fall term to identify four possible project topics. Only students for whom Dr Clinton is not an adviser or reader are eligible to participate in the project. This is to ensure that there is no confusion of research and academic supervision roles. The student participants will be anonymous to Dr Clinton and were not identified in the project report. To note that Dr Clinton is a professor at the Hariri School of Nursing (HSON), my advisor and my first reader for this project.

2. Recruitment of Research Participants

Any MSN student who will be enrolled in NURS 580 Project in spring 2015 is eligible to participate in the study except for any student for whom Dr Clinton is adviser or reader. Any information sheet will be distributed to all final year MSN students at orientation and at start of classes in fall 2014. Students who would like more information about the study will be asked to contact me for further information.

C. Procedure

1. Individual Briefing of Participants

Prior to online data collection, the investigator met with the participants individually and asked them about what they will take into account when deciding the topic of their MSN project.

Each participant was provided with the following list of possible criteria:

1. Relevance to my current job.
2. Need for IRB approval.
3. Relevance to my future career.
4. Topic that is a priority for my employer.
5. Apply a statistical procedure I want to learn.
6. Relevant to the interests of my academic adviser.
7. Fewest demands on my time.
8. Easiest to write up.
9. Help me to get a better job.
10. Prepare me for my PhD.

Each participant was asked to:

1. Delete any of the above that will not take into account
2. Add to the list of criteria.

Participants logged in the online software and completed the pair comparisons. They continued the on-line exercise by entering the working titles of up to four projects they considered working on, and used the software to rate each of their choices.

Finally, interviews were conducted with the four students to ask whether the online process helped them choose the project they want to work on.

2. The BPMSG AHP Online System component

The AHP Online package handles complete AHP sessions. It consists of four sections. First, the registration/log in phase where the participant has to log in to access the system and initiate an AHP session. Second, the AHP priority calculator which helps to translate individual preferences into numbers and assigns weights for a set of criteria based on pairwise comparisons. Third, the AHP hierarchy which allows to define a hierarchy of criteria and to calculate weights for all criteria based on pairwise comparisons and to evaluate alternatives. The last component of the AHP Online system is the AHP group session which allows members to participate in AHP group sessions to evaluate criteria or alternatives. The group session code is provided by the session chair.

3. Post AHP Process Interview

The purpose of the interviews was to assess whether the online process helped the four participants choose the project they want to work on. The investigator met each of the participants individually in a classroom with a computer at the Hariri school of Nursing.

The participants were interviewed just after having completed their AHP sessions.

The questions that were used in the interview were:

Question1: Did you find the online pairwise rating exercise helpful?

Question 2: Was there anything in your results that you found surprising?

Question 3-1: Was there anything in the online process that was unhelpful?

Question 3-2: On a scale of 1 to 10, 1 = not at all to 10 = I used the process to finalize

my choice of project, how did you find the online process? Note that the 1-10 rating scale applies to this question only; all rating of decision criteria will be on a scale of 1-9.

Question 4-1: Would you recommend this decision making process to MSN students to MSN students trying to decide on a project topic?

Question 4-2: If yes, Why? If not, Why not?

Question 5: Is there anything else you would like to say about the AHP process?

D. Instrumentation

The AHP software was used for rating the criteria and weighting students' choice of their project topic.

E. Ethical considerations

There are no risks involved in this study other than those encountered by graduate students in everyday life. The greatest risks are those to privacy (who the students are) and confidentiality. Anonymity will be protected. The current version of the program allows participants not to input their real names. Only the chair of the group session (Myself) will see the participants' pseudonyms, if necessary. Group sessions are protected by the group session code (6 char random). The group session code serves as a password for participants to input their judgments. Participants can enter their online data at a private location of their choice. Dr Klaus, the developer of the Open Source software has a service provider, a company in Singapore with the following privacy policy (Appendix A). Dr Klaus noted that "The current version of the program allows participants to see the group results showing all participants names (as

they input it, must not be their real name) and AHP priorities. This could be easily changed in a way that either only the chair of the group session can see the participants' names or the participants name is anonymized, if necessary. Group sessions are protected by the group session code (6 char random). The group session code serves as a password for participants to input their judgments" (personal communication between Dr Clinton and Dr Klaus on 5th June, 2014).

CHAPTER FIVE

RESULTS

A. Prioritization and Ranking of Decision Criteria

The top three criteria that were found important to students when selecting a project were:

"Relevance to my current job" was found to be the top priority when deciding on project topic, followed by "relevance to my future career" then “interest in the selected population”. In descending order of importance, the least three influences on selection of project topic were: “Prepare me for my PhD, “fewest demand on my time” and “easiest to write up”. Neither the workload involved in completing the study nor the ease of writing up the results was a major influence on choice of project topic.

Table 5.1. Overall prioritization and ranking of decision criteria (N=4)

	Decision Criteria	Priority	Rank
1	Relevance to my current job	79.9%	1
2	Relevance to my future career	59.8%	2
3	Interest in the selected population	48.7%	3
4	Help me get a better job	43.2%	4
5	Relevant to the interest of my academic advisor	17.4%	5
6	Prepare me for my PhD	22.8%	6
7	Fewest Demand on my time	9.6%	7
8	Easiest to write up	8.6%	8

B. The Usefulness of AHP in Selecting a Project Topic

The four participants found the AHP process helpful when choosing the topic for their three credit point capstone project. One of the participants qualified this by stating only if the student was unsure about the choice of topic. The four participants

recommended the AHP process to other students when choosing their projects because it helps to recognize personal interests and priorities and to organize ideas.

Furthermore, the participants mentioned that the AHP provide a good mind map and a smart system.

Figure 5.1. The Utility of the AHP in Selecting the Student's Project Topic

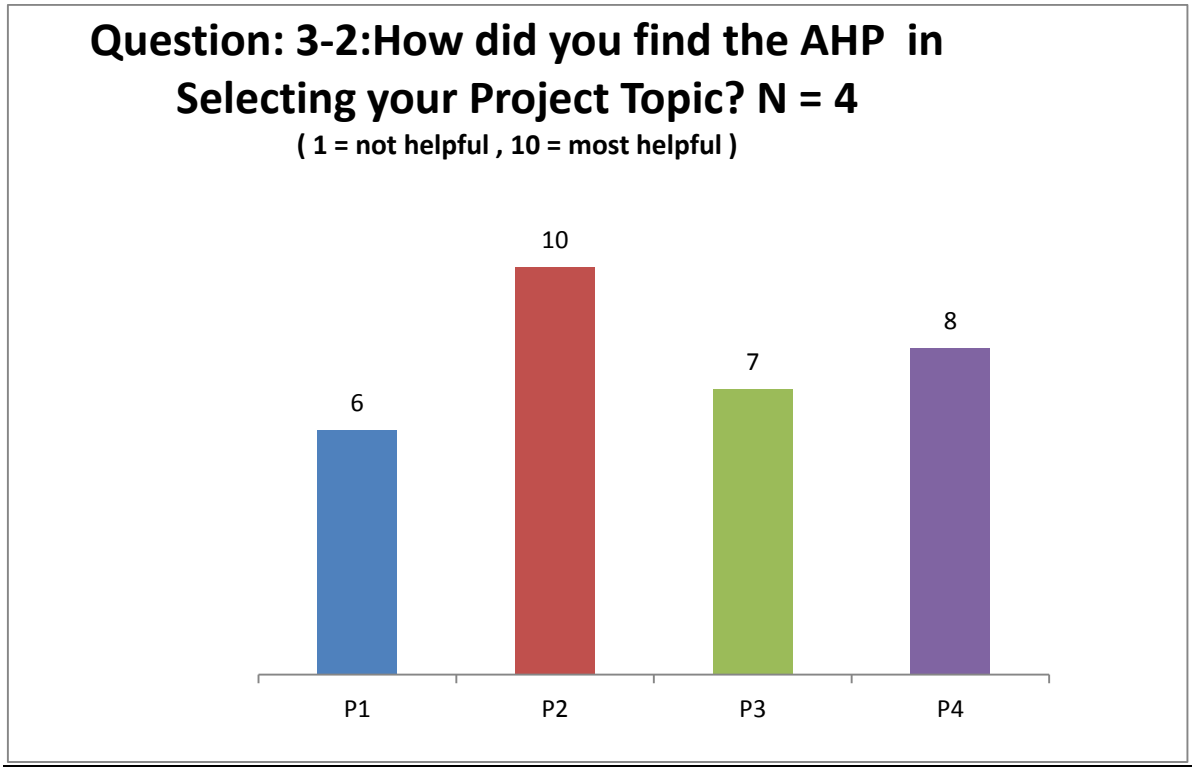
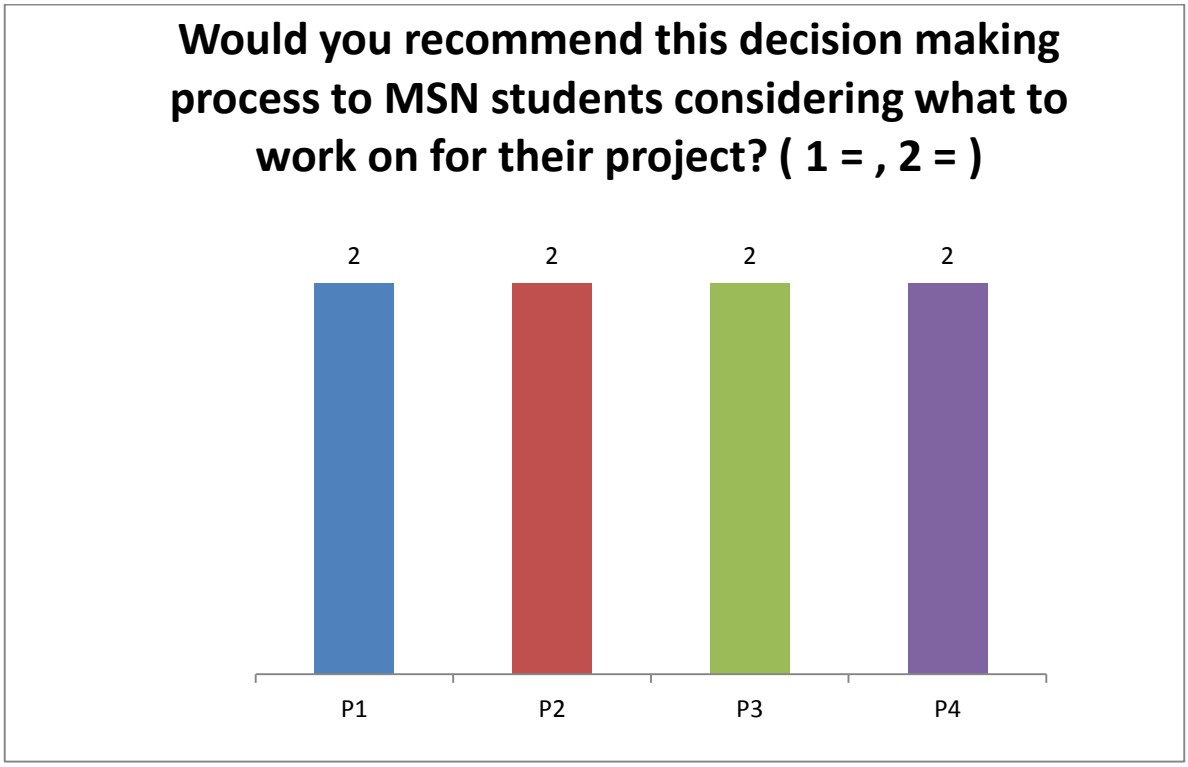


Figure 5.2. The Utility of an Open Source Software Package for Conducting AHP



1=No
2= Yes

Adding to the above, all four participants said that nothing was unhelpful. Assistance with using the online software would have been appreciated.

C. Discussion

As stated above, the objectives of the study are to determine whether Master of science in Nursing students find the AHP process helpful when choosing the topic for their three credit capstone project and to test the utility of an open source software package for conducting AHP. The findings of the study showed that the AHP process is an effective tool for students for choosing their capstone project. The literature shows the effectiveness of the AHP process and this is consistent with the results of this study.

This was a “proof of concept” study confined to four MSN students only which would affect the validity of the result. It needs to be repeated with a larger sample of students to further assess the usefulness of the AHP process and the utility of the AHP online software. The AHP also requires data based on experience, knowledge and judgment which are subjective for each participant. A potential limitation is the rank reversal problem, if any criteria or alternative is to be added, the priorities might change and result in rank reversal. AHP has been criticized for not providing sufficient guidance about plotting criteria and alternatives in a hierarchy. As the levels of hierarchy increase so do the number of pairwise comparisons (Hartwick, 1999).

CHAPTER SIX

LIMITATIONS AND CONCLUSION

A. Limitations and Future Studies

The study implies the use of the AHP process in decision making process pertaining to choosing a master's project is helpful. It can be recommended for decision making processes when the number of participants is relatively small such as in this study. Involving other faculty and nursing students in AHP studies is something to look for in the future as well as promoting the use of the AHP process in decision making processes in nursing related issues, in clinical units and in nursing administration. However, the study was conducted on a small sample, each track in the MSN program was only represented by one student, the study was conducted after the students had already made up their minds about the projects they wanted to do, and the decision making criteria were provided for the students.

Similar studies with larger groups of MSN students are needed. Decision making elements should be elicited from faculty as well as students. The process studies should involve only those students genuinely facing difficulty in selecting a project topic. The AHP process could be used by advisers as part of the regular process of counseling students.

AHP studies could be conducted on other decision making processes related to nursing such as: weighting the different factors contributing to the nursing shortage in Lebanon. Evaluating nursing curricula for undergraduate and graduate nursing programs. Shortlisting candidates for nursing positions.

B. Conclusion

AHP is a useful and well established approach to sound decision making. The AHP software (BPMSG AHP online System) is a convenient way for project leaders to involve stakeholders in structured group decision making. The software is readily available, easy to download, is covered by a confidentiality agreement, and highly flexible www.hostg.com/legal/privacy-policy.php The AHP online software can be used for individual or group decision making processes. MSN students select topics for their capstone projects for a variety of reasons. The use of the AHP process in this project indicated that the most important criteria MSN students take into account are: Relevance to my current job, relevance to my future career, interest in the selected population and help me get a better job. The AHP provides a mechanism for improving consistency in decisions.

APPENDICES

APPENDIX I

PRIVACY POLICY

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APPENDIX II

ORAL CONSENT DOCUMENT

Title of project: Application of the analytical hierarchical process to student decision making

Investigators:

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Hello. My name is Eva Tabarani. I am a Master in Nursing Sciences student in the Hariri School of Nursing at AUB conducted by Dr Michael Clinton and myself. I would like to invite you to participate in a research study about whether using the Analytic Hierarchy Process helps students to decide on the topic they want to do for their MSN capstone project. The purpose of the study is found out whether MSN students find the Analytical Hierarchy Process helpful when choosing a project topic.

Before we begin, I would like to take a few minutes to explain why I am inviting you to participate and what will be done with the information you provide. Many MSN students find it very difficult to select a topic for their project. Therefore, the purpose of our study is to find out whether an Open Source software package can help students decide which project to do. If you agree to be involved, you will be one of four students, one from each MSN track, who will help us evaluate the process and the software.

Should you decide to be involved, you will be asked to fill out a short online survey. The survey involves you deciding on the relative importance of criteria MSN students might use when deciding on their project focus. The criteria will be presented to you in pairs and for each pair you will need to decide which criterion is more important on a scale of 1 to 9. When you have finished rating all the pairs, you will be asked to rate four self-selected project titles using each of the criteria. At the end the software will show you your list of project titles in the order of importance to you based on your ratings. The process will take around 30 to 40 minutes. I can be with you to help you with the process if you wish.

After you have taken the online survey, I would like to interview you about perceptions of the software and whether the process has helped you to choose or finalize your choice of project topic. The interview will take around 20 to 30 minutes, possibly shorter. Altogether, the study will take around 1 hour of your time or a bit more.

If you decide to be involved, you will be one of four MSN students, one from each of the MSN tracks (Administration, Adult Care, Psychiatry, Community) taking part in the study.
To be eligible to participate, you **must** be planning on doing your project in spring semester 2015 and **must not** have Dr Clinton as your advisor or reader (since Dr Clinton is an investigator in this study, this will avoid any conflict of interest).

We will protect your privacy by asking you to use a pseudonym when taking the online survey and will not refer to you by name in any report, presentation, or publication arising from the research. We not refer to your choice of topic in any report, presentation or publication arising from this research. Only you will now which project you chose to do and whether you changed your mind later.

We will protect the confidentiality of the data by deleting the online files immediately after downloading aggregate results for each of the four students. The anonymized downloaded files will be stored on Dr Clinton's password protected computer in HSON until for a period of three years. Ms. Tabarani will delete her any data files stored on her personal password protected computer, immediately she has submitted her MSN project report.

Your participation in this research study is entirely voluntary. You can decline to take part and your decision will not involve penalties of any kind or your relationship with HSON or AUB.

If you voluntarily agree to take part in the study, you can skip any item in the online survey or decline to answer interview questions. You can also withdraw from the study at any time without explanation. None of these actions will have any consequences or penalties of any kind and will not affect your relations with HSON or AUB.

If you have any questions, you are free to ask them now. If you have questions later, you may contact me at emt01@aub.edu.lb, Eva Tabarani, mobile no: 78890450 or Dr Clinton: mc42@aub.edu.lb ext. 5956. If you have questions about your rights as a participant in this research, you can contact the following office at AUB:IRB: irb@aub.edu.lb,01350000 ext. 5445.

Please note that there is no need to use your true name when online or at any time during this study.

Do you have any questions?

Are you interested in participating in this study?

APPENDIX III

RECRUITMENT SCRIPT

My name is Eva Tabarani, I am a master's student in nursing at the HSON. I am conducting a project about the effectiveness of AHP. I am writing to you to participate in my project. This is completely voluntary; you can choose to be in the study or not. The study does not involve any risks. If you would like to know more about the study, please email me at emt01@aub.edu.lb.

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