# Status of Mathematics Researches in Ilocos Region: Basis for Mathematics Research Agenda

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**Abstract -** *This study describes the status of Mathematics researches of State College and Universities (SUCs') in Ilocos Region (Region I) through content analysis of the undergraduate and graduate students' theses and dissertation, and faculty researches conducted from the year 2008 to 2014. Research results revealed that mathematics researches were produced by undergraduate students and limited on institutional level. The thematic focus, were on enhancement of known theories and concepts in Mathematics. The use of statistical tools was usually avoided and if ever needed, these tools were limited to basic statistical tools. Research types were mostly mixtures of qualitative and quantitative with strategies of inquiry as mostly exploratory. The data gathered used questionnaire or from secondary sources. A classification tree was used to model the level of researches where the research theme turned out to be the most important variable followed by the research discipline, statistical tools employed and scope of the study. Researchable areas and prospective components were identified in the formulated Mathematics research agenda in their order of priorities based on the problems and focus.*

**Keywords:** *Mathematics theme, Mathematics focus, Mathematics research agenda*

## INTRODUCTION

Mathematics is the gate and key of sciences and serves as the basic concept of science and technology. It occupies a vital position in the educational system because the demand for it is evident in everyman's life. Kant, [1] a philosopher cited that "a science is exact only in so far as it employs mathematics". Hence, all scientific education which do not commence with Mathematics are defective at its foundation. He further said that, "In every department of physical science there is only so much science, properly so-called, as there is mathematics"[2]. Therefore, Mathematics is everywhere and endless.

Meanwhile, "Mathematics is the most versatile of all the sciences. It is uniquely well placed to respond to the demands of a rapidly changing economic landscape. Mathematics now has the opportunity more than ever before to under-pin quantitative understanding of industrial strategy and processes across all sectors of business. Companies that take best advantage of this opportunity will gain a significant competitive advantage: mathematics truly gives industry the edge" Professor Arnold [3].

Over the last few years issues connected with learning and teaching mathematics have become a matter of the highest importance for everyone involved in education, training and publishing. It has been taken up at the highest policy level [4]. Mathematical competence has been identified by the European Parliament and the Council of the European Union as one of the key competences necessary for personal fulfillment, active citizenship, social inclusion and employability in modern society.

The member-states of the Association of Southeast Asian Nations (ASEAN), including the Philippines, envisioned an ASEAN University born from strong linkages of leading universities and institutions in the region. ASEAN 2015 [5**]** promote greater educational cooperation among ASEAN Member States and strengthen education within them. Julio Amador III [6], came up with collaboration in research and extension as one issues the country must ponder on as a member-state of ASEAN.

Several researches are made yearly from Basic Education to Higher Educational Institutions to find answers to issues and problems particularly in mathematics subjects that mathematics teachers are

encountering in their quest to transfer quality education to the youth . However, these mathematics researches are seldom classified or quantified of how many researches fall under social or purely mathematical in content. Hence, there's too little information that recommends or encourage researchers to research in some areas that need concentration. Since, Mathematics is one of the priority cluster of disciplines of National Higher Education Research Agenda (NHERA)[7], it was therefore the aim of this research to identify key themes in mathematics researches, and to map the concentration of mathematics education research within and across those themes. Moreover, this study formulated possible mathematics research agenda for the next five years. Through accumulation of evidences from research in mathematics education, it is now possible to identify clear questions that warrant further research.

The following reviewed studies added insight to the completion of this study: Dayag et. al [8], Voskoglou [9] Hyde et.al [10], Sloane [11] conducted researches about trends and challenges. On the other hand, Yu-Chen Su [12] Bozkurt [13], made use of content analysis in their researches. While, Bozkaya et.al [14], GÖKTAŞ et. al [15] Tang Wee Teo et. al[16], established trends in various disciplines and at the same time made use of content analysis technique.

## OBJECTIVES OF THE STUDY

This study described the status of Mathematics researches among SUC's in Ilocos Region using those conducted from 2008 to 2014. Specifically, it aimed to: establish **t**he trend of the mathematics researches conducted by the undergraduate students, graduate students and faculty researchers in terms of their (a) general characteristics as to educational level of researchers, respondent type, discipline, and scope of research (b) thematic research focus and discipline as to educational theory and research themes (c) research methodology as to research type, data analysis, strategies of inquiry, sampling scheme / procedures and instruments and materials used; derive a model of classification of the level of researches as function of the aforementioned properties, and; propose a mathematics education research agenda for the next five years.

## METHODOLOGY

This study employed content analysis[17] thru methodological review of the completed mathematics researches of faculty, theses and dissertations of undergraduate and graduate students in the State Universities and Colleges (SUCs) in Ilocos Region for the past seven years (2008-2014). It considered all the Mathematics researches that offer the following programs: BS Mathematics, Master's Degree in Mathematics and Doctoral Degree in Mathematics in the under graduate and graduate level during the specified time period.

A researcher-made questionnaire served as the main instrument of the study. The research instrument was composed of three parts. Part 1 established the general characteristics of the mathematics researches in terms of the educational level of the researchers, respondent type, mathematics discipline and the scope of the research. Part II described the educational theory and research themes of the mathematics researches. Lastly, Part III, established the research methodology. This included the research design, data analysis, strategies of inquiry, sampling scheme and data collection methods and instruments used in the mathematics researches.

List of study titles and electronic database of the abstracts were first studied to speed up selection of the studies to be analyzed. Questions in the checklists were answered while a study was selected and carefully studied.

Quantitative analysis was done in the gathered data. Answers in the checklists were analyzed using frequency counts and percentage measures. Summary of results were presented in tabular order. Classification tree analysis was used in modeling the level of researches in the region.

## RESULTS AND DISCUSSION

### Trends of Mathematics Researchers

The general characteristics of researches are usually described in terms of level, respondent type, focus and disciplines.

**Educational level of researchers.** Table 1 shows the distribution of mathematics researches as to the educational level of the researchers from 2008 to 2014. Undergraduate theses consistently remain to be the highest in frequency throughout the observed periods. The volume of the researches for the years considered ranged from 26 to 39 and these came from undergraduate programs that require thesis such as BS Mathematics, BS Applied Mathematics and BS

Statistics. For the Bachelor of Secondary Education major in Mathematics, thesis is not a requirement and thus no research was considered in this program. Notice however, that that there was no notable increase in the number of undergraduate theses as determined from the sequence with very low increase and almost stationary. For seven years, only 238 undergraduate researches in Region 1 were produced which is equivalent to about 35 to 36 theses per year. This figure is a clue to the small number of graduates of Math- based degrees in the region.

As seen in Table 1, there were only 72 Master theses and dissertations in Mathematics produced from 2008 to 2014 or equivalent to ten researches per year produced by graduates of masteral and doctoral courses who specialized in Mathematics. While almost all schools in the region offer graduate courses in mathematics, researches in Mathematics in the region were very thin. The data sequence is decreasing incrementally which is indicative of dwindling number of graduates in the masters programs. Table also shows researches of mathematics teachers was very minimal, an indication that very few teachers were involved in research activities. A total of 16 researches in math distributed almost equally for the period of seven years were produced by math teachers. This exhibits almost stationary trend which is an indication of lack of stimulating factors for Mathematics teachers in the region to conduct research.

**Respondent type**. Table 2 displays the classification of the respondents considered by the Mathematics researchers in studies that involved results of survey analysis. Almost 200 (61.04%) of the total 326 studies did not report whatever thing about their respondents. This can be due to the reason that researchers were focused on theoretical enhancement or developmental studies. Considering those studies that performed survey, the most popular type of respondents were the students (31. 60%). This can perhaps be owed to the reason that students are the most practical, expedient and willingly accessible subjects. Other respondents considered were administrators, faculty, and mixture of faculty and students but they were not as common as the students as clearly seen in Figure 3.

**Table 1. Distribution of Researches in Mathematics as to the Educational Level of the Researchers from 2008 to 2014**

| Variable | | Educational Level | | | Total |
|---|---|---|---|---|---|
| | | Undergraduate theses | Masters theses and dissertations | Faculty researches | |
| 2008 | Count | 34 | 14 | 3 | 51 |
| | % | 66.67 | 27.45 | 5.88 | |
| 2009 | Count | 26 | 15 | 5 | 46 |
| | % | 56.52 | 32.61 | 10.87 | |
| 2010 | Count | 35 | 12 | 2 | 49 |
| | % | 71.43 | 24.49 | 4.08 | |
| 2011 | Count | 35 | 9 | 3 | 47 |
| | % | 74.47 | 19.15 | 6.38 | |
| 2012 | Count | 39 | 5 | 1 | 45 |
| | % | 86.67 | 11.11 | 2.22 | |
| 2013 | Count | 30 | 16 | 2 | 48 |
| | % | 62.50 | 33.33 | 4.17 | |
| 2014 | Count | 39 | 1 | 0 | 40 |
| | % | 97.50 | 2.50 | 0.00 | |
| TOTAL | Count | 238 | 72 | 16 | 326 |
| | % | 73.01 | 22.09 | 4.91 | |

**Table 2. Distribution of the Researches in Mathematics as to the Type of Respondents**

| Year | | Respondent type | | | | | |
|---|---|---|---|---|---|---|---|
| | | Administrator | Students | Faculty | Faculty and Students | None | Total |
| 2008 | Count | 0 | 15 | 2 | 3 | 31 | 51 |
| | % | 0.00 | 29.41 | 3.92 | 5.88 | 60.78 | |
| 2009 | Count | 0 | 15 | 1 | 1 | 29 | 46 |
| | % | 0.00 | 32.61 | 2.17 | 2.17 | 63.04 | |
| 2010 | Count | 0 | 14 | 4 | 3 | 28 | 49 |
| | % | 0.00 | 28.57 | 8.16 | 6.12 | 57.14 | |
| 2011 | Count | 1 | 10 | 1 | 3 | 32 | 47 |
| | % | 2.13 | 21.28 | 2.13 | 6.38 | 68.09 | |
| 2012 | Count | 0 | 23 | 0 | 1 | 21 | 45 |
| | % | 0.00 | 51.11 | 0.00 | 2.22 | 46.67 | |
| 2013 | Count | 0 | 21 | 1 | 3 | 23 | 48 |
| | % | 0.00 | 43.75 | 2.08 | 6.25 | 47.92 | |
| 2014 | Count | 0 | 5 | 0 | 0 | 35 | 40 |
| | % | 0.00 | 12.50 | 0.00 | 0.00 | 87.50 | |
| **Total** | **Count** | **1** | **103** | **9** | **14** | **199** | **326** |
| | **%** | **0.31** | **31.60** | **2.76** | **4.29** | **61.04** | |

**Discipline**. Mathematics is very expansive covering various disciplines. As seen in Table 3, many (35.58%) researches were focused on the application of mathematics to areas like computer programming needed in system development studies, econometrics, instrument reliability and statistical modelling. Math Analysis or Calculus was the most popular discipline being considered followed by linear and abstract algebra. There were little studies that focused on statistics, trigonometry, geometry but none on numerical analysis, topology, graph theory, mathematical statistics and other disciplines.

**Table 3. Distribution of the Researches as to the Mathematics Discipline Considered**

| | | Discipline | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Trigo-nometry | Statistics | Geometry | Math Analysis/ Calculus | Linear/ Abstract /College algebra | General /Applied | Total |
| 2008 | Count | 2 | 4 | 3 | 12 | 12 | 18 | 51 |
| | % | 3.92 | 7.84 | 5.88 | 23.53 | 23.53 | 35.29 | 1.0 |
| 2009 | Count | 0 | 1 | 7 | 12 | 11 | 15 | 46 |
| | % | .00 | 2.17 | 15.22 | 26.09 | 23.91 | 32.61 | 1.0 |
| 2010 | Count | 1 | 4 | 4 | 11 | 7 | 22 | 49 |
| | % | 2.04 | 8.16 | 8.16 | 22.45 | 14.29 | 44.90 | 1.0 |
| 2011 | Count | 2 | 2 | 3 | 11 | 12 | 17 | 47 |
| | % | 4.26 | 4.26 | 6.38 | 23.40 | 25.53 | 36.17 | 1.0 |
| 2012 | Count | 3 | 3 | 6 | 19 | 8 | 6 | 45 |
| | % | 6.67 | 6.67 | 13.33 | 42.22 | 17.78 | 13.33 | 1.0 |
| 2013 | Count | 1 | 5 | 3 | 14 | 8 | 17 | 48 |
| | % | 2.08 | 10.42 | 6.25 | 29.17 | 16.67 | 35.42 | 1.0 |
| 2014 | Count | 0 | 1 | 2 | 15 | 1 | 21 | 40 |
| | % | .00 | 2.50 | 5.00 | 37.50 | 2.50 | 52.50 | |
| **Total** | **Count** | **9** | **20** | **28** | **94** | **59** | **116** | **326** |
| | **%** | **2.76** | **6.13** | **8.59** | **28.83** | **18.10** | **35.58** | |

**Scope**. Table 4 shows the distribution of researches as to the scope of the study. While information and communication today happen around the globe so quick because of high speed internet connectivity, movement of most mathematics researches in the region since the past seven years is still stationarized at the institutional level (50.92%) and that only six (6) studies went above to at least provincial level. The other studies did not define their scope as they were simply theoretical enhancement or developmental and perceptibly categorized as institutional.

**Table 4. Distribution of the Researches in Mathematics as to Scope**

| YEAR | | Scope | | | | | |
|---|---|---|---|---|---|---|---|
| | | **institutional** | **provincial** | **regional** | **international** | **Not defined** | **Total** |
| 2008 | Count | 27 | 0 | 0 | 0 | 24 | 51 |
| | % | 52.94 | .00 | 0.00 | 0.00 | 47.06 | |
| 2009 | Count | 25 | 0 | 0 | 0 | 21 | 46 |
| | % | 54.35 | .00 | .00 | .00 | 45.65 | |
| 2010 | Count | 34 | 1 | 0 | 0 | 14 | 49 |
| | % | 69.39 | 2.04 | .00 | .00 | 28.57 | |
| 2011 | Count | 17 | 0 | 1 | 1 | 28 | 47 |
| | % | 36.17 | .00 | 2.13 | 2.13 | 59.57 | |
| 2012 | Count | 26 | 1 | 0 | 0 | 18 | 45 |
| | % | 57.78 | 2.22 | .00 | .00 | 40.00 | |
| 2013 | Count | 27 | 1 | 1 | 0 | 19 | 48 |
| | % | 56.25 | 2.08 | 2.08 | .00 | 39.58 | |
| 2014 | Count | 10 | 0 | 0 | 0 | 30 | 40 |
| | % | 25.00 | 0.00 | 0.00 | .00 | 75.00 | |
| **Total** | **Count** | **166** | **3** | **2** | **1** | **154** | **326** |
| | **%** | **50.92** | **.92** | **.61** | **.31** | **47.24** | |

**Thematic Research Focus and Discipline**

**Table 5. Distribution of the researches in mathematics as to Educational Theory**

| Year | | Educational Theory | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Basic Learning** | **Psychological** | **Sociological** | **Communication and Media** | **Learning and Psychological** | **Concept enhancement** | **Total** |
| 2008 | Count | 2 | 2 | 0 | 0 | 0 | 47 | 51 |
| | % | 3.92 | 3.92 | .00 | .00 | .00 | 92.16 | |
| 2009 | Count | 5 | 2 | 0 | 3 | 0 | 36 | 46 |
| | % | 10.87 | 4.35 | .00 | 6.52 | .00 | 78.26 | |
| 2010 | Count | 4 | 0 | 3 | 0 | 1 | 41 | 49 |
| | % | 8.16 | .00 | 6.12 | .00 | 2.04 | 83.67 | |
| 2011 | Count | 1 | 0 | 0 | 1 | 1 | 44 | 47 |
| | % | 2.13 | .00 | .00 | 2.13 | 2.13 | 93.62 | |
| 2012 | Count | 4 | 3 | 0 | 2 | 0 | 36 | 45 |
| | % | 8.89 | 6.67 | .00 | 4.44 | .00 | 80.00 | |
| 2013 | Count | 1 | 1 | 0 | 0 | 0 | 46 | 48 |
| | % | 2.08 | 2.08 | .00 | .00 | .00 | 95.83 | |
| 2014 | Count | 4 | 2 | 1 | 0 | 1 | 32 | 40 |
| | % | 10.00 | 5.00 | 2.50 | .00 | 2.50 | 80.00 | |
| **Total** | **Count** | **21** | **10** | **4** | **6** | **3** | **282** | **326** |
| | **%** | **6.44** | **3.07** | **1.23** | **1.84** | **.92** | **86.50** | |

Table 5 displays the distribution of researches in mathematics as to educational theory realized in the study. Of these theories, the most common were the basic learning theories (6.44%) categorized as: problem- based, constructivist, and engagement. Other theories generated from mathematics studies were psychological (3.07%), sociological (3.07%), communication and media (1.84%) and combination of basic learning and psychological (0.925).

Table 6 displays the distribution of researches in mathematics classified by theme. It can be seen in the table that assessment study is in the top of the list. These assessment studies were usually focused on academic performance of the students in various areas discipline of mathematics described in terms of basic descriptive statistics or advanced nondeterministic classificatory models. In addition to the academic performance, some issues were also the focuses of assessment like social issues on poverty, k-12 programs, political leader preferences, and workplace of BS Math and other Math-related courses.

Media studies and development of instructional materials and other application software were also the theme of some researches. Most popular instructional materials being developed were Computer –Aided instruction (CAI) while system application software developed were used in business and database management.

**Table 6. Distribution of the researches in mathematics as to Research Theme**

| Year | | Research theme | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | Media study | Assessment | Design and Development | Conceptual and Theoretical Enhancement | various themes | |
| 2008 | Count | 4 | 15 | 3 | 19 | 10 | 51 |
| | % | 7.84 | 29.41 | 5.88 | 37.25 | 19.61 | |
| 2009 | Count | 3 | 13 | 2 | 13 | 15 | 46 |
| | % | 6.52 | 28.26 | 4.35 | 28.26 | 32.61 | |
| 2010 | Count | 1 | 22 | 2 | 8 | 16 | 49 |
| | % | 2.04 | 44.90 | 4.08 | 16.33 | 32.65 | |
| 2011 | Count | 1 | 15 | 1 | 10 | 20 | 47 |
| | % | 2.13 | 31.91 | 2.13 | 21.28 | 42.55 | |
| 2012 | Count | 1 | 32 | 0 | 4 | 8 | 45 |
| | % | 2.22 | 71.11 | .00 | 8.89 | 17.78 | |
| 2013 | Count | 2 | 24 | 0 | 13 | 9 | 48 |
| | % | 4.17 | 50.00 | .00 | 27.08 | 18.75 | |
| 2014 | Count | 1 | 23 | 1 | 1 | 14 | 40 |
| | % | 2.50 | 57.50 | 2.50 | 2.50 | 35.00 | |
| **Total** | **Count** | **13** | **144** | **9** | **68** | **92** | **326** |
| | **%** | **3.99** | **44.17** | **2.76** | **20.86** | **28.22** | |

**Table 7. Distribution of the researches in Mathematics as to Research Design**

| Year | | Research type | | | Total |
|---|---|---|---|---|---|
| | | quantitative | qualitative | Mixed/ hybrid | |
| 2008 | Count | 2 | 1 | 47 | 51 |
| | % | 3.92 | 1.96 | 94.12 | |
| 2009 | Count | 2 | 0 | 44 | 46 |
| | % | 4.35 | .00 | 95.65 | |
| 2010 | Count | 1 | 0 | 48 | 49 |
| | % | 2.04 | .00 | 97.96 | |
| 2011 | Count | 0 | 0 | 47 | 47 |
| | % | .00 | .00 | 100 | |
| 2012 | Count | 3 | 0 | 42 | 45 |
| | % | 6.67 | .00 | 93.33 | |
| 2013 | Count | 0 | 1 | 47 | 48 |
| | % | .00 | 2.08 | 97.92 | |
| 2014 | Count | 0 | 0 | 40 | 40 |
| | % | .00 | .00 | 100 | |
| **Total** | **Count** | **8** | **2** | **316** | **326** |
| | **%** | **2.45** | **.61** | **96.93** | |

## METHOD

**Research type**. Table 7 displays the distribution of researches in mathematics as to the research design being adopted such as pure quantitative, qualitative and mixed. Many studies were judged as pure qualitative or quantitative. In can be seen in Table 7 that only eight (8) studies were classified as pure quantitative and only 2 can be considered qualitative. Noticed however that many studies were combination of study types and do not possess the unique characteristic of being qualitative or quantitative and they are thus considered as mixed or hybrid studies. The corresponding to studies of mixed type suggests that researches in the region are mixture of varied types of studies.

## DATA ANALYSIS

**Statistical Tools**. Table 8 displays the distribution of the researches in Mathematics in terms of the Statistical tools used for the period 2008-2014. Notable findings are the studies which did not make use of any statistical tool (62.58%). This is expected since many studies were theoretical enhancements and developmental and thus did not involve any statistical analysis. On the other hand, of those that used statistical tools, there were still many studies who made use of basic descriptive and parametric tools (22.70%). Very common among the descriptive tools was frequency count for categorical variables and average weighted mean for scale variables. Summated scale and Likert scale were very prominent wherein inferences about the target population were made using the result of basic statistical tools such as: t-test and ANOVA (F-test) for comparison; chi-square, Pearson r and Spearman rho for correlation; and simple linear regression for prediction.

There were studies (14.72%) that made use of some advance statistical tools. These studies were usually those that aimed to come up with a statistical model based on the measured interrelationship among variables. These studies involved model building strategies using advanced statistical tools built in many modern statistical software. Advanced exploratory statistical procedures found in use were factor analysis and correspondence analysis while advanced tools in classification and prediction used where multiple stepwise regression, discriminant analysis, logistic regression, and probit analysis.

Advanced non-parametric tools found in statistical software that work on the principle of Artificial Intelligence such as conjoint analysis, classification tree and multilayer perceptron were found out to be appearing in some research. As the old statistical software are being upgraded now and then, new procedures are being introduced changing gradually the landscape of data analysis. Fortunately, some researchers in the region were somehow being rationalized by these changes.

**Table 8. Distribution of the researches in mathematics as to Statistical Tools Used**

| Year | | statistical tool | | | |
|---|---|---|---|---|---|
| | | Basic descriptive and inferential statistics | Advance predictive and multivariate statistical tools | No statistical tool | Total |
| 2008 | Count | 10 | 6 | 35 | 51 |
| | % | 19.61 | 11.76 | 68.63 | |
| 2009 | Count | 8 | 6 | 32 | 46 |
| | % | 17.39 | 13.04 | 69.57 | |
| 2010 | Count | 11 | 13 | 25 | 49 |
| | % | 22.45 | 26.53 | 51.02 | |
| 2011 | Count | 10 | 3 | 34 | 47 |
| | % | 21.28 | 6.38 | 72.34 | |
| 2012 | Count | 14 | 5 | 26 | 45 |
| | % | 31.11 | 11.11 | 57.78 | |
| 2013 | Count | 11 | 4 | 33 | 48 |
| | % | 22.92 | 8.33 | 68.75 | |
| 2014 | Count | 10 | 11 | 19 | 40 |
| | % | 25.00 | 27.50 | 47.50 | |
| **Total** | **Count** | **74** | **48** | **204** | **326** |
| | **%** | **22.70** | **14.72** | **62.58** | |


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**Strategies of inquiry.** Table 9 displays the distribution of the researches in Mathematics in terms of strategies of inquiry. As seen in the table, most research problems studies in mathematics were answered in descriptive (29.45%) and exploratory (56.13%) ways. There were also study that made use of combinations of several strategies (9.82%) while very few performed the experimental strategies in answering their queries. Developmental studies usually were mixed with descriptive strategy while theoretical enhancement were classified as exploratory.

**Table 9. Distribution of the researches in mathematics as to Strategies of Inquiry**

| YEAR | | Strategies | | | | | |
|---|---|---|---|---|---|---|---|
| | | Experimental | Quasi Experimental | Descriptive | Exploratory | Mixed Method | Total |
| 2008 | Count | 1 | 0 | 12 | 33 | 5 | 51 |
| | % | 1.96 | .00 | 23.53 | 64.71 | 9.80 | |
| 2009 | Count | 5 | 0 | 11 | 25 | 5 | 46 |
| | % | 10.87 | .00 | 23.91 | 54.35 | 10.87 | |
| 2010 | Count | 0 | 0 | 16 | 27 | 6 | 49 |
| | % | .00 | .00 | 32.65 | 55.10 | 12.24 | |
| 2011 | Count | 0 | 0 | 12 | 28 | 7 | 47 |
| | % | .00 | .00 | 25.53 | 59.57 | 14.89 | |
| 2012 | Count | 3 | 1 | 15 | 20 | 6 | 45 |
| | % | 6.67 | 2.22 | 33.33 | 44.44 | 13.33 | |
| 2013 | Count | 3 | 2 | 16 | 24 | 3 | 48 |
| | % | 6.25 | 4.17 | 33.33 | 50.00 | 6.25 | |
| 2014 | Count | 0 | 0 | 14 | 26 | 0 | 40 |
| | % | .00 | .00 | 35.00 | 65.00 | .00 | |
| TOTAL | **Count** | **12** | **3** | **96** | **183** | **32** | **326** |
| | **%** | **3.68** | **.92** | **29.45** | **56.13** | **9.82** | |

*Table 10. Distribution of the researches in mathematics as to Sampling Scheme*

| Year | | Sampling Scheme | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | Simple random | Stratified random | Cluster | Non-probability | No sampling performed | Complete enumeration | |
| 2008 | Count | 0 | 6 | 0 | 8 | 36 | 1 | 51 |
| | % | .00 | 11.76 | .00 | 15.69 | 70.59 | 1.96 | |
| 2009 | Count | 2 | 5 | 0 | 6 | 32 | 1 | 46 |
| | % | 4.35 | 10.87 | .00 | 13.04 | 69.57 | 2.17 | |
| 2010 | Count | 1 | 5 | 0 | 5 | 37 | 1 | 49 |
| | % | 2.04 | 10.20 | .00 | 10.20 | 75.51 | 2.04 | |
| 2011 | Count | 0 | 2 | 0 | 8 | 37 | 0 | 47 |
| | % | .00 | 4.26 | .00 | 17.02 | 78.72 | .00 | |
| 2012 | Count | 7 | 2 | 0 | 7 | 28 | 1 | 45 |
| | % | 15.56 | 4.44 | .00 | 15.56 | 62.22 | 2.22 | |
| 2013 | Count | 7 | 4 | 0 | 6 | 31 | 0 | 48 |
| | % | 14.58 | 8.33 | .00 | 12.50 | 64.58 | .00 | |
| 2014 | Count | 5 | 9 | 1 | 0 | 25 | 0 | 40 |
| | % | 12.50 | 22.50 | 2.50 | .00 | 62.50 | .00 | |
| **Total** | **Count** | **22** | **33** | **1** | **40** | **226** | **4** | **326** |
| | **%** | **6.75** | **10.12** | **.31** | **12.27** | **69.33** | **1.23** | |

**Sampling scheme**. Sampling is a very crucial stage of research usually those that involve survey of a wider group of respondent. As seen in Table 10, 12.27% involved non-probability sampling were mostly were purposive. Many studies did not involve sampling because all the members of the population were taken (1.23%) and the others, it's not needed in the study (69.33%). On the other hand for those who performed probability sampling, 6.75% performed simple random sampling while stratified was the more popular (22.5%). In stratified random sampling, student course is the most popular basis for stratification.

In sampling theory, there are criteria being set for the choice on what variable to use as basis for stratification like the mean level and the internal variability of the population within each stratum as a function of the mean level. Ignoring these criteria, will make stratified sampling less precise over simple random sampling. One important purpose of stratification is the estimation of parameters wherein each mean of the strata are being averaged to come up with a weighted mean that is used in the estimation. Unfortunately, most researchers ignored these assumptions and estimation and made use only of stratified random sampling as a method in obtaining random samples.

Table 11 shows the distribution of mathematics researches as to the instruments used. The use of secondary instruments (20.55%) and questionnaires (19.02%) are the most popular instruments and materials used in the conduct of mathematics researches in the region. Though the figure shows that other instruments such as interview (16.87%), observation (15.95%) field notes(12.88%), achievement tests (13.80%) are also often used as research instruments. It only shows that the researchers are exposed to wide variety of instruments in the conduct of their study.

**Tree Model of the Mathematics Researches**

Tree analysis was used in this study to model the works of the undergraduate, graduate, and faculty researchers by growing a classification tree using the variables stated in the previous sections. Table 12 shows the classification table of the undergraduate, graduate and faculty researches. Using the tree model, 88.2% and 77.8% of the works of undergraduate and graduate researchers respectively were classified correctly. It can be noticed in the table that all researches of faculty were incorrectly classified. This is an indication that the kind of researches that Mathematics faculty developed have no common focus or not fastened on a particular agenda

**Table 11. Distribution of the researches in mathematics as to Instrument Used**

| Year | | Instrument | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Questionnaire** | **Interview** | **Observation** | **Field notes** | **Achievement tests** | **Secondary documents** | **Total studies** |
| 2008 | Count | 20 | 1 | 2 | 0 | 11 | 11 | 51 |
| | % | 39.22 | 1.96 | 3.92 | .00 | 21.57 | 21.57 | |
| 2009 | Count | 7 | 23 | 2 | 1 | 0 | 12 | 46 |
| | % | 15.22 | 50.00 | 4.35 | 2.17 | .00 | 26.09 | |
| 2010 | Count | 11 | 11 | 26 | 2 | 0 | 0 | 49 |
| | % | 22.45 | 22.45 | 53.06 | 4.08 | .00 | .00 | |
| 2011 | Count | 0 | 10 | 8 | 23 | 5 | 3 | 47 |
| | % | .0 | .2 | .2 | .5 | .1 | .1 | |
| 2012 | Count | 1 | 0 | 11 | 6 | 26 | 11 | 45 |
| | % | 2.22 | .00 | 24.44 | 13.33 | 57.78 | 24.44 | |
| 2013 | Count | 7 | 0 | 0 | 10 | 2 | 29 | 48 |
| | % | 14.58 | .00 | .00 | 20.83 | 4.17 | 60.42 | |
| 2014 | Count | 16 | 10 | 3 | 0 | 1 | 1 | 40 |
| | % | 40.00 | 25.00 | 7.50 | .00 | 2.50 | 2.50 | |
| **Total** | **Count** | **62** | **55** | **52** | **42** | **45** | **67** | **326** |
| | **%** | **19.02** | **16.87** | **15.95** | **12.88** | **13.80** | **20.55** | |


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**Table 12. Classification Table of Undergraduate, Graduate and Faculty Researches**

| Observed | Predicted | | | |
|---|---|---|---|---|
| | Undergraduate theses | Masters theses and dissertations | Faculty researches | Percent Correct |
| Undergraduate theses | 210 | 28 | 0 | 88.2% |
| Masters theses and dissertations | 16 | 56 | 0 | 77.8% |
| Faculty researches | 10 | 6 | 0 | .0% |
| Overall Percentage | 72.4% | 27.6% | .0% | 81.6% |

Using Automatic Chi Square Interaction Detection (CHAID) as a tree growing method, new categories of the independent variables significantly associated with the dependent variable are formed automatically by splitting the observed values or merged those categories of the independent variables that are not significantly different with respect to the dependent variable. At each step of the tree growth, CHAID chooses the variable that has the strongest interaction with the research type and this results to data segmentation.

As seen in the root node of the ternary tree, mathematics researches in Region I were dominated by undergraduate theses (73%). The theme of the research is the most important variable that determined the kind of researches there are in the Region as to the educational level of the researcher. At a very high value of Chi square (177.49) and a p value of 0.000, it can be seen that the kind of research as to the educational level of the author can be classified significantly and most importantly by the type of research theme. As exhibited in node 3 at height 1 of the tree, media study, statistical modelling and software development were seem to be the attentions of most undergraduate researchers. Of the 168 researchers who had these themes, 158 or 94% were conducted by undergraduate researchers. Very popular among these was the statistical modelling of various response variables like level of contentment, satisfaction or agreement over a particular social issues. Prediction and classificatory analyses of the response variables using several explanatory variables were the most common wherein probabilistic models were univariate and multivariate multiple linear regression involving dummy variables, and logistic regression.

Mixtures of various research themes aside from those considered was also the theme of the 66.2 % of undergraduate researchers who ventured on these themes. Some 21.7% of the totality under this category were master theses and dissertations. On the other hand 13% of these were faculty researches. Although this was another dominated theme of undergraduate theses, the percentage was lower compared to statistical modeling (94%). The graduate researchers as 67.6% of these were masters theses and dissertations. There were also undergraduate researchers (29.4%) which focused on conceptual and theoretical enhancement and 2.9% were developed by faculty researchers.

Each of the nodes on the first level (height 1) of the tree branched out resulting to more nodes and some of these are considered terminals or leaves. In tree analysis, newly born nodes suggest an improved classification of the parent node. As for those who had conceptual and theoretical enhancement as their theme, research discipline is still an important factor that should not be ignored. In the fourth (node 4) and fifth nodes (node 5), works of graduate researchers dominated in all the mathematics discipline considered. But although this was the case, graduate researches have greater dominance in abstract algebra and trigonometry as 95.8% of those who worked on abstract algebra and trigonometry were graduate researches. In other discipline such as statistics, Geometry, and analysis, graduate researches also dominated but only at 52.3% while undergraduate theses were also highly concentrated in these discipline at 45.5%.

Node 3 represents those who focused on design and development or statistical modeling. This theme was dominated by undergraduate theses (95.2%) and very few (4.8%) were masters' theses, dissertations, and faculty researches. Notice that under node 3, the kind of researches can be significantly classified ( $\chi^2 = 40.338, p = 0.000$) based on the kind of statistical tools being used in the research analyses as exhibited by the three child nodes (9, 10, 11). As can be seen in node 10, all those who used descriptive

statistics were undergraduate researchers (100%). For those who used basic statistics, undergraduate researches again dominated this (94.6%). For other studies who did not use statistical tool particularly developmental research, 91.4% were undergraduate researches.

Under node 9, another important variable $\left(\chi^2 = 21.618, p = 0.000\right)$ to consider among those who did not use statistical tool is the scope of the study. For those limited to institutional, 95.7% were undergraduate researches while for non-institutional, 100% were all undergraduate researches.

Many mathematics researches were written using wide array of themes other than design and development, modeling and theoretical enhancement. Under this, undergraduate researches were again dominant but compared to other themes, the concentration was only 65.2% with masters theses at 21.7% and faculty researches at 13%. Next important variable $\left(\chi^2 = 21.618, p = 0.000\right)$to consider in classifying researches under this theme is the research discipline.

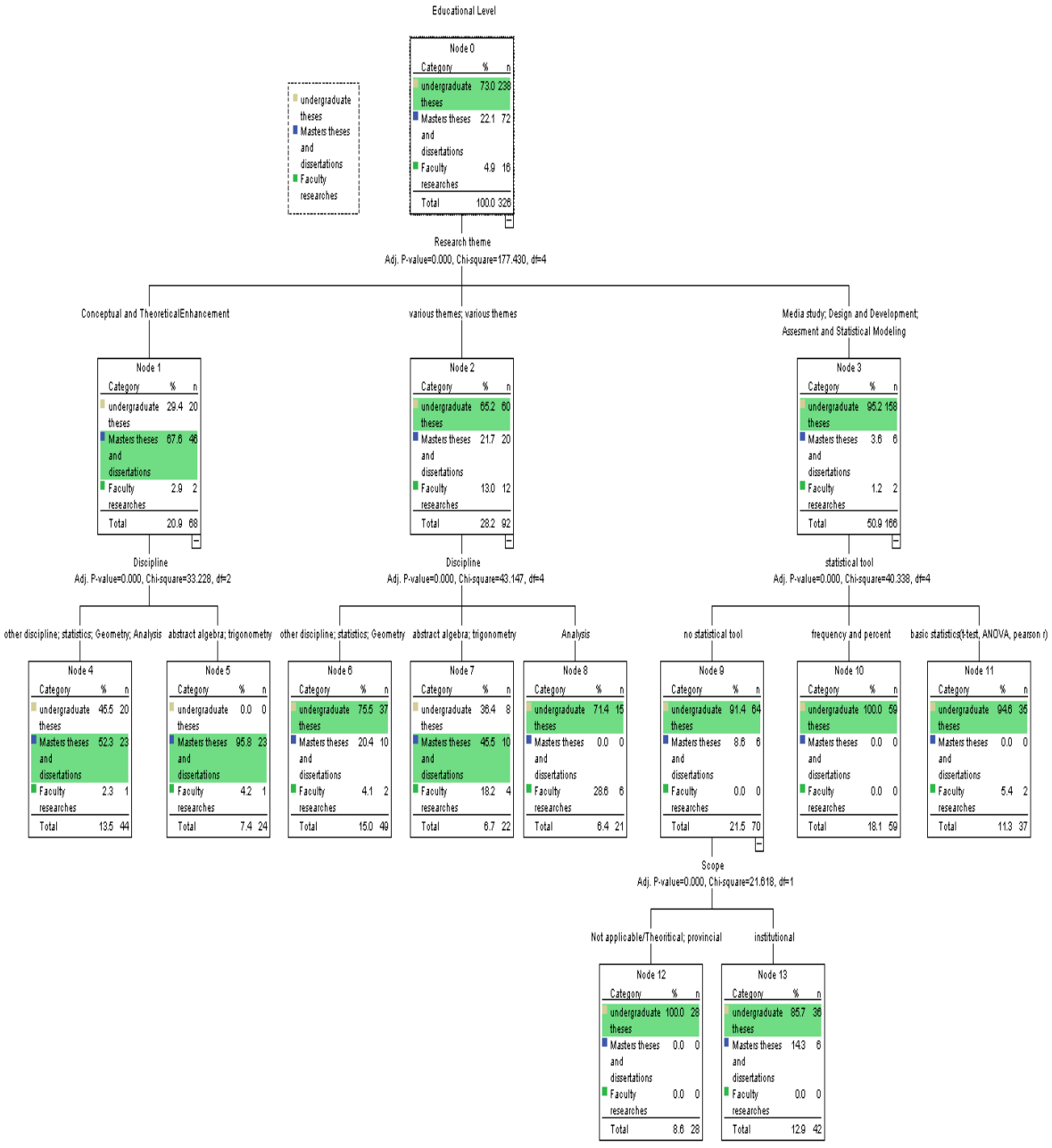

**Table 13. Gains for Nodes using undergraduate researches as the target category**

| | Node | | Gain | | | |
|---|---|---|---|---|---|---|
| **Number** | **N** | **Percent** | **N** | **Percent** | **Response** | **Index** |
| 10 | 59 | 18.1% | 59 | 24.8% | 100.0% | 137.0% |
| 12 | 26 | 8.0% | 26 | 10.9% | 100.0% | 137.0% |
| 11 | 37 | 11.3% | 35 | 14.7% | 94.6% | 129.6% |
| 13 | 44 | 13.5% | 38 | 16.0% | 86.4% | 118.3% |
| 6 | 49 | 15.0% | 37 | 15.5% | 75.5% | 103.4% |
| 8 | 21 | 6.4% | 15 | 6.3% | 71.4% | 97.8% |
| 4 | 44 | 13.5% | 20 | 8.4% | 45.5% | 62.3% |
| 7 | 22 | 6.7% | 8 | 3.4% | 36.4% | 49.8% |
| 5 | 24 | 7.4% | 0 | .0% | 0.0% | 00.0% |
| | 326 | | 238 | | | |

**Table 14. Gains for Nodes using graduate researches as the target category**

| | Node | Node | | Gain | | |
|---|---|---|---|---|---|---|
| | | **N** | **Percent** | **N** | **Percent** | **Response** | **Index** |
| | 5 | 24 | 7.4% | 23 | 31.9% | 95.8% | 433.9% |
| | 4 | 44 | 13.5% | 23 | 31.9% | 52.3% | 236.7% |
| | 7 | 22 | 6.7% | 10 | 13.9% | 45.5% | 205.8% |
| | 6 | 49 | 15.0% | 10 | 13.9% | 20.4% | 92.4% |
| dimension0 | 13 | 44 | 13.5% | 6 | 8.3% | 13.6% | 61.7% |
| | 10 | 59 | 18.1% | 0 | 0.0% | 0.0% | 0.0% |
| | 11 | 37 | 11.3% | 0 | 0.0% | 0.0% | 0.0% |
| | 12 | 26 | 8.0% | 0 | 0.0% | 0.0% | 0.0% |
| | 8 | 21 | 6.4% | 0 | 0.0% | 0.0% | 0.0% |

Table 13 shows the different gains for the nodes where only the terminal nodes or the nodes where the tree stops growing are listed. Terminal nodes are of interest because they represent the best classification for the model.

In terms of the nodes, for node 10, 18.1% of the total researches were focused on design and development and statistical modeling that used descriptive statistics and basic testing tools wherein most of these were works of undergraduate researchers.

As can be realized from Table 13, undergraduate researches were highly concentrated in node 10 where 24.8% of the 238 undergraduate researches were found in this node. It is expected that for a research concerning media, design and development of instructional material or assessment study that uses basic statistical tools it is a work of an undergraduate researcher.

Response is the percentage of cases in the node in the specified target category. These are the same percentages displayed for the undergraduate category in the tree diagram.

Table 14 also displays the Index described as the ratio of the response percentage for the target category compared to the response percentage for the entire sample. As described before, there were % of the entire sample that were classified as undergraduate researches and in node 10, 100% is the response thus the index is 137%. An index value of greater than 100% in a particular node means that there are more cases of the target category in that node compared to the overall percentage of that target category in the entire sample. This means that in region I it is estimated that 73% of researches were written by undergraduate but this estimation will improve if the researches are concerned on media, design and development of instructional material or assessment study that made use of basic statistical tools in their data analyses (node 10). As seen in Table 13, improvement in estimation can be expected on nodes 12, 11, 13 and 6.

Among the nine terminal nodes, graduate researches were mostly concentrated in node 5 and 4. In node 5, 31.9 % of the 72 graduate researches were

concentrated in this node while another 31.9% were concentrated in node 4.

Improvement in the estimation and classification is noteworthy in nodes 5,4, and 7 as the index values exceed 100% for these nodes.

## PROPOSED 2016-2020 MATHEMATICS RESEARCH AGENDA

The research areas on Mathematics were identified based on the findings of this study on the characteristics of Mathematics researches in Region I. The formulation of the research agenda for the next five years will support the National Higher Education Research Agenda (NHERA) Priority Research Areas/Themes for the year 2008 – 2018. The formulation of the proposed agenda was guided by the principles parallel to that used by the NHERA namely: (1) ***Multidisciplinary***. Researches that involve the expertise of researchers in several disciplines are preferred over researches needing the expertise in a single discipline; (2) ***Policy orientation.*** Policy- oriented researches are preferred over researches that have little or no policy implication across the various higher education disciplines ; (3) ***Participation and networking***. The research should involve the participation of as many stakeholders as possible and should be organized preferably as network, instead of stand alone, undertaking of an HEI or individual researcher (4) ***Balanced attention to basic and applied research***. Both basic or pure research and applied research shall be given due importance.

Figure 14 depicts the weak points of the mathematics researches in the region. This weak points serve as the bases of this study in coming up with the proposed agenda for 2016-2020.

Considering the identified weak points discussed above about the mathematics researches in the region for the past seven years, the proposed mathematics research agenda for 2016-2020 is displayed on the next page. The concern/issue, researchable area, priority and prospective proponent were written in table form to realize the research agenda easily.

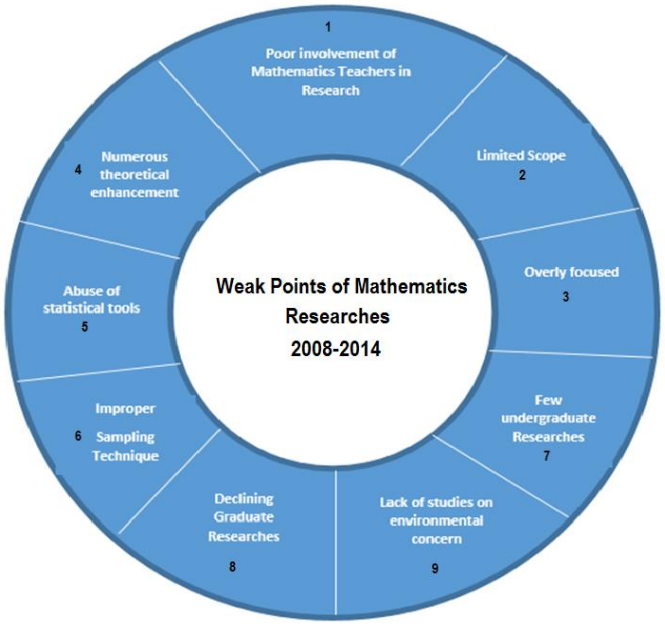


Figure 14. Illustrative Diagram of the concerns and issues of mathematics' Researches in the Region as input to the proposed Mathematics Agenda for 2016-2010

**Table 15. The proposed Mathematics Research Agenda**

| Concern/Issue | Researchable Area | Priority | Prospective Proponent |
|---|---|---|---|
| Poor Involvement of Mathematics Teachers in the Conduct of Research | Assessment of the factors that hinder mathematics faculty to conduct research:<br>(a) personal factor<br>(b) job--related factors | 1 | Mathematics Faculty and Administrators |
| The scope of study in Mathematics in the Region was limited to institutional level | Collaborative study in mathematics of different state university in the region and in the country that will focus on cultural practices depicted in the touches of mathematical patterns in their respective products like furniture, potteries, etc. | 2 | Mathematics faculty in the region |
| Overly focused researches in Calculus, Algebra and Geometry | Studies in other areas of mathematics less explored like Numerical Analysis, Graph Theory, Mathematical Statistics, Discrete Mathematics | 3 | BSMath or MA/MS math students |
| Numerous studies on theoretical and conceptual enhancement | Application of the Enhanced Mathematical Theories in Economics, Information Technology, Business, Applied Statistics, Actuarial Sciences etc. | 4 | Undergraduate students teamed with undergraduate students of Economics, IT, Business, and Sciences |
| Abuse of basic statistical tools in data analysis | 1. Awareness of researches on the assumptions of most statistical tools<br>2. Application of data mining, neural network technology, and artificial intelligence in the analysis of research data | 5 | Students under the BS Stat program or BS Math major in Statistics |
| Lack of theoretical background of the researchers about sampling techniques and their applications | Comparison of the performance of different sampling method using computer simulated and actual data in reducing sampling error | 6 | Students under the BS Stat program or BS Math major in Statistics |
| Low enrolment in BS Mathematics and math-related program<br>as evidenced by the small number of researches produced by undergraduate students in Math program and its ally | Tracer study of BS Math graduates in the region<br><br>Assessment of the industry needs of graduates of math related courses | 7 | Math faculty in the region |
| Declining number of math researches produced by graduate students | Analysis of pattern of academic progression of Graduate students in Mathematics | 8 | Math faculty and Ed.D/PhD students in math |
| Lack of Studies on Environmental concerns | Mathematical Model of the Effect of Climate Change on Human and the Environment: A collaborative study | 9 | Mathematics and Science Teachers in Region I |

## CONCLUSIONS AND RECOMMENDATIONS

Based on the result of this study, it was found out and concluded that: (1) through the years, the mathematics researches in the region are generally produced by undergraduate students and focus mainly on Calculus. Survey studies have the respondents as mostly students who were selected using non-probability sampling and limited mostly to institutional level. In terms of thematic focus, researches are basically about enhancement of known theories and concepts in Mathematics and thus the use of statistical tools are being avoided and if ever needed, these tools are classified as basic statistical tools. The design are mixtures of qualitative and quantitative with strategies of inquiry as mostly exploratory. The data were gathered using questionnaire or from secondary sources; (2) the decision tree model depicting the classification of mathematics researches in region is a function of the research theme, discipline, statistical tools employed and the scope of the study. The research theme is the most important significant variables. For those with themes on conceptual enhancement, the next important variable is the mathematics discipline. On the other hand for those researches with themes on design and development, media studies, and statistical modelling, the next important variable is the statistical tools being employed. For those who have not used statistical tools, the scope of the study is the next important variable; (3) several researchable areas and prospective components are identified in the formulated mathematics research agenda in their order of priorities based on the problems and focus found out in this study.

Having known the trend of the mathematics researches, the proposed **Mathematics Research Agenda** for the next five years is strongly recommended by this study to be implemented in the higher educational institutions in the region.

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