Path Analysis of Direct and Indirect Effect of Statistical literacy on Applying Proper Statistical Test (Case Study of agricultural extension and education graduated students)

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Abstract: Research methods, statistical analysis and domination on subject are essential for a rich dissertation and thesis to be developed. The main goal of this study was to obtain the perception of the agricultural extension and education graduated students about their statistical literacy, reasoning and thinking according to standard tests and to trace thematic evolution (content analysis) of dissertations and thesis done by the same graduated students according to sequential statistics analysis approach (SSAA). To this end, the study analyzed 315 thesis and dissertation to understand, how and to what extent, proper and mix statistical methods are applied to achieve realistic outcomes. In the other hand, 115 questionnaires were fulfilled, containing statistical standard tests about statistical literacy, reasoning, thinking, attitude, content knowledge and principal component of statistics learning. According to the path analysis results, the statistical attitude (total effect=0.80) had the most effect (direct and indirect effect) on applying statistical methods.

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1. Introduction

The growth of agriculture and nature resources as scientific disciplines especially agricultural extension, education and development that have the maximum accordance to social and behavioral sciences depend on many variables (Dyre et al 2003). Flyvbjerg (2001) argued many researches were driven by a continuing belief that the social and political world could be measured through objective, empirically testable and law-like data indicators.

Fincher (1991) stressed that "research on the substantive issues is handicapped by higher education, s lack of status and recognition as an academic discipline and or professional specialty", the issue of understanding research as a disciplined inquiry is still stealth, especially in higher education. Likewise, Dijkum (2001) indicated that analysis of the practice of social research shows there is no easy answer to the question of how the knowledge of the natural sciences can be used to further understanding in the social sciences. It is useful to know that the inseparable section of scientific inquiry is statistical analysis and one of the important sections of statistics is using tests to analyze data. To obtain appropriate data, knowing and dominating on the superior plan or approach is necessary, so using mix and sequential proper statistical tests to realize accurate outcomes help researchers. Accordingly, there are more expectations from thesis and dissertation as an academic inquiry.

As indicated by Windish and Diener-West (2006) and Govindrajulue (2004), there are a few, if any, references for using sequential statistics in the literature. Although choosing the right statistical tests for a particular set of data appears to be an overwhelming task. According to Wheater and Cook (2000) particularly, if such decisions are rendered after data are collected, the sequences and the placements of statistical tests to understand their role and mission are in the first place. Wheater and cook (2000) believe that an investigator is definitely responsible for choosing statistical methods. Therefore, she/he must be able to use statistics effectively to organize, evaluate, and analyze the data (Whitney, 2005). To ease the dilemma, it is helpful to identify the level of statistical literacy, reasoning and thinking of researcher. Also it is important to know if the student as a researcher has selected the statistical tests mix or general and if she/he has holistic view about statistical methods election or not? On the other hand, use of statistics as an analysis process in an especially operational research has a vital role to obtain a relatively correct response; however it makes a statistics anxiety (Zeidner, 1991). Eventually, this paper wants to know if usage of sequential statistical analysis approach (SSAA) can help to solve the statistical anxiety and test s' misused among post

graduated students and also if it assists them to develop their statistical literacy, reasoning and thinking ability by meeting their basic needs.

Theory and rationale

Before starting this part, we have to explain the content that will be examined by it and to specify certain theories or perspectives that indicate the content. Statistics has seen as a science of variability and a way to deal with the uncertainty that surrounds us in sciences and our life (Kendall, 1968; Moore, 1997). In particular, statistics is used to describe and to predict the phenomena that require collections of measurements. But what are the essential skills to navigate today's technology and information-laden society?

Students have problems to learn statistics (Meletiou & Lee, 2002). It may be because of some wrong learned statistical concepts and applications. Malek Mohammadi (2009) posed a model in the sequential statistical analysis approach (SSAA) to present a mixed and sequential method. In this model, he mixed three phases and divided each phases to several steps that researchers should use them to refine and improve research; they are as following:

A. Initial phase

1- Variable mining and measurement

-causes associated with the research problem (Cohen et al., 2002),

-kind of research (Moyusky, 1995; Wadsworth, 2005; dinove, 2008),

- Research question (Cohen et al., 2002; Bruin, 2006; Marion, 2004),

-the aim of analysis (Cohen et al., 2002),

-Kind of variable (Wheater&Cook, 2000, MacGraw, 2007; Watt &Vandenberg, 2002; porter, 2001),

-Variable measurement (Kaminsky, 2008; Watt &Vandenberg, 2002; porter, 2001).

2- Variable reduction (refinery)

-Validity and reliability (Ferrando, 2009),

-Coefficient of variability (Malek Mohamadi, 2009),

-Correlation matrix (Malek Mohamadi, 2009).

3- Variables or respondents groping (exploratory factor analysis [EFA])

-Exploratory factor analysis (EFA) (Salkind, 2008).

B. intermediate (inferential phase)

1-Variable and groups identification

-Independent/dependent or endogenous /exogenous variable (Hill&Lewicki, 2007; Kaminsky, 2008),

-Number of groups being compared (Watt &Vandenberg, 2002; porter, 2001),

-Kind of group being compared (Watt &Vandenberg, 2002; porter, 2001)

2- Hypothesis development

-Main hypothesis (Graveter&Forzano, 2008),

3- Hypothesis testing (choosing the appropriate statistical test)

-P value / effect size (Dixon, 2009; Denis, 2003),

-Sample size and complexity of data (McDonald, 2008),

-Central limit theorem (McDonald, 2008; Moyusky, 1995; Wadsworth, 2005),

-Number of independent hypothesis or multiple comparisons

-Paired or unpaired (Moyusky, 1995),

-Parametric/ nonparametric (Moyusky, 1995),

-Choosing the appropriate statistical test (Watt &Vandenberg, 2002; porter, 2001),

C. advanced (modeling) phase\

1- Regression (multiple and multivariable)

2- Structural equation modeling (SEM),

-Path analysis (Salkin, 2008),

-Confirmatory factor analysis (Maroulides, 2006)

Each of the phases is composed of a few steps within which there are general and specific criteria for selecting and applying statistical tests.

To this end, having statistical literacy is a requirement for researchers to understand and use the approach.

Statistical literacy

As more information technology, and world oriented societies, citizens need to sound understand about basic statistics to face with social demands front of them to get consciousness decisions. But what are the basic stats for these people? Probability and Statistics educators to answer this question address people to the statistical literacy.

There are many definitions of statistical literacy. It is defined by Wallman(1993) as "ability to critical evaluation and understand of results that is associated with the ability to be encouraged to participate in statistical thinking that can be in the public and private or professional and personal decisions form."

It is completed by Gal (2002); that required community statistical literacy is composed of two components:

(a) People's ability to interpret and critically evaluate statistical information, data-related arguments, or stochastic phenomena, which they may encounter in diverse contexts, and when relevant

(b) their ability to discuss or communicate their reactions to such statistical information, such as their understanding of the meaning of the information, their opinions about the implications of this information, or their concerns regarding the

acceptability of given conclusions. He also suggested that statistical literacy required making people empowerment to interpret statistical data and critical evaluation, discussion-based data, or random phenomena. Likewise, Watson (2006) sees statistical literacy as the "meeting point of the chance and data curriculum and the everyday world, where encounters involve unrehearsed contexts and spontaneous decision-making based on the ability to apply statistical tools, general contextual knowledge, and critical literacy skills" (Watson, 2006). Chick, Pfannkuch and Watson (2005) describe statistical literacy as 'transnumerative thinking' where students will be able to make sense of and use different representations of data to make sense of the world around them. Gal and Garfield (1997) see statistical literacy as the need for students to be able interpret results from studies and reports and to be able to "pose critical and reflective questions" about those reports because "most students are more likely to be consumers of data than researchers".

Statistical literacy is needed for many reasons: the statistics commonly discussed will be used in the fields of political, economic and social. Students with statistical literacy better are able to use statistical aspects on the social debate to read and interpret. Many students have problem in the areas of statistics discussions. Students have problem with comments and alternative interpretations of statistically events. Students often mistakenly conclude (Chiarella, 2001).

Gal (2002) suggests that statistical literacy involves both knowledge elements and dispositional elements described in the enclosed model. Applied together, they form the basis for statistical literacy. A look at this model shows that statistical literacy is based upon the availability of literacy knowledge and skills, as much as about content knowledge in relevant areas in statistics and mathematics (figure 1).

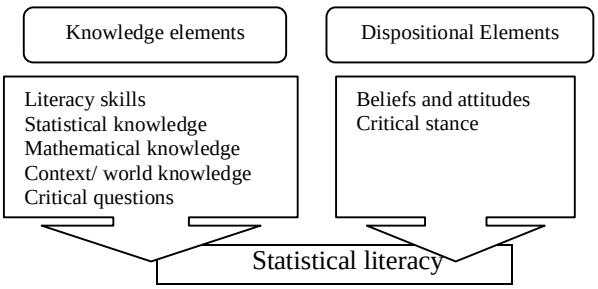

Figure 1- elements of statistical literacy

Meanwhile Statistical Knowledge is a critical component of this model. Clearly, knowledge of statistical and probabilistic concepts and procedures is required for statistical literacy. But since Delams (2002) posed two models that in one of them, statistical literacy was supposed as the all-encompassing goal of instruction and statistical reasoning and thinking no longer have independent content. In this model there are no parts of the domains separate from statistical literacy. In this model statistical reasoning and statistical thinking become "sub-goals within the development of the statistically competent citizen and they have overlapping with together (figure 2).

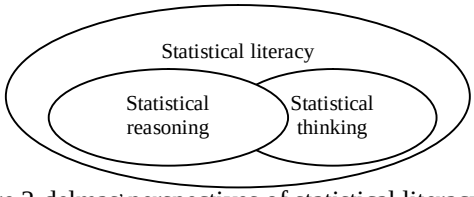

Figure 2-delmas' perspectives of statistical literacy

Statistical thinking

Both Ben-Zvi and Garfield (2004) and Chance (2002) cited Statistical thinking including understanding about why and how reviews are done and "big ideas" as areas for statistical assessment. These ideas include the nature of distribution, when and how to use appropriate methods to analyze data such as summarizing numerical data and visual display of data. Statistical thinking, including understanding the nature of sampling and how researcher can inference from sample for statistical population, and why to create cause and effect relationship is required design experience. This includes understanding how to use the model for simulation a random phenomenon. Also for a review process, how, when and why the existing inductive devices can be used. Statistical thinking also includes being able to understand and difficult field advantage in shaping the review, draw conclusions and to identify and understand the processes has been entered (consider the question of collecting data to analyze selected for testing hypotheses etc). Finally, critical thinkers and statistical evaluation of results of a problem or statistical methods are capable.

Wild and Pfannkuch (1999) five basic types of statistical thinking expressed:

1) recognize the need for Contracts (more than mere attention to the linguistic evidence);
2) trans numeration - ability to get good data that show the real situation to change and provide the data to obtain additional means more of them;
3) Due to Distribution - This means to make judgments about the data is described, including search and dispersal patterns and try to understand in relation to these areas is
4) reasoning about models - from simple (such as tables and charts) to complex; like

those can be found in the pattern, and summarization of data using multiple and

5) Summary statistics - Create relationship between two things that are essential components for statistical thinking.

Elsewhere is that the process of statistical thinking from Groth (2003) perspective is following:

1- Describing Data: The explicit reading of data presented in tables, charts, or graphs.
2- Organizing and Reducing Data: Arranging, categorizing, or consolidating a given set of data into summary form.
3- Representing Data: Displaying a given set of data by using graphs.
4- Analyzing Data: Identifying trends and making inferences or predictions from a data display or set, using formal inferential methods when appropriate.
5- Collecting Data: Planning, conducting, and critiquing surveys, experiments, and observational studies.

Statistical Reasoning

In comparison, statistical reasoning may be defined as the way people reason with statistical ideas to make sense of statistical information (Garfield & Gal, 1999). Ben-Zvi and Garfield (2004) describe statistical reasoning as interpretation of data and its different representations. This includes the interpretation based on those data, the data presented, summarizing the data is. Statistical reasoning may involve a relationship some concepts with another concepts (such as centralization and variability), or may combine ideas about data and probability. Reasoning means understanding and able to explain statistical processes and the ability to interpret statistical results is complete. For example, statistical reasoning about binary variables include to know how to judge the relationship between two variables and interpret and typically include translation or restore processes between rows of data, graphing relations and express the statistical reason of them(Aquilonius,2005). Garfield (2003) describes a five level hierarchy for statistical reasoning that ranges from idiosyncratic reasoning, where students have little or no understanding of words, symbols and concepts, through to integrated process reasoning where students have a complete understanding of a statistical process. Understanding and using statistical language is seen as significant. Sooth Garfield presented a statistical model. He wants that students have greater access to better understanding. His definition of statistical reasoning was the way people argue about statistically ideas and statistically information significance. Understandings of this argue is conceptual understanding of important ideas such as dispersion, centralization, randomize, and sampling (Garfield, 2003).

Interestingly, Garfield suggests that critiquing media reports may be one way to assess statistical reasoning.

The interrelatedness of statistical literacy, statistical reasoning, and statistical thinking does potentially make it difficult for teachers to design lessons or assessments that would meet all the competing goals. DelMas (2002) makes a final attempt to describe the features of statistical literacy, statistical reasoning, and statistical thinking by focusing not on the context or content of

Problems but what teachers ask students to do with the context or content. DelMas outlines in Figure 3assessment questions that are asked in tasks for statistical literacy, reasoning and thinking that would involve students being in “one domain more so than in another” (DelMas, 2002).

Basic literacy	Reasoning	Thinking
Identify Describe Rephrase Translate Interpret Read	Why? How? Explain (the process)	Apply Critique Evaluate Generalize

Figure 3-Three instructional domains

Again it appears here that DelMas (2002) is attempting to limit statistical literacy to a procedural literacy. Statistical reasoning appears to be the ‘doing’ of statistics and statistical thinking the ‘questioning’. While this may be attractive as a description we must contrast the attempts by Delmas et al (1999) to characterize statistical literacy as statistical, graphical or technical competency with researchers and educators (Gal, 2002, Schield, 2005; Watson, 2006) who characterize statistical literacy as a much wider analytical and critical literacy. In this definition statistical literacy focuses on understanding what is being presented, asking good questions and then evaluating arguments, As Schield asserts; “statistical literacy is more about questions than answers” (Schield, 2005)

2. Material and Methods

The methodology used in this study involved a combination of descriptive and quantitative, especially operational research (OR). Operational research is the discipline of applying advanced analytical methods to help making better decisions. By using techniques such as mathematical modeling to analyze complex situations, operational researches give executives power to make more effective

decisions and build more productive systems base on data mining and modeling. To gather pure and first hand data, thesis and dissertations were assessed by content analysis. Actually, extracted information from them was compared with standard check list to recognize measure and percentage of accordance of applied statistical methods and sequential statistical analysis approach (SSAA) (Malek Mohammadi, 2009). The level of statistical literacy, reasoning and thinking of graduated students, extracted from questionnaire, were compared with findings of content analysis. These notions were actively supported by standard form such as ILS (Vermunt and Vermetten, 2004), SRA (Garfield, 2003) and SATs (Sorto, 2004; Burrren, 2008). Independent variables were the level of statistical literacy, reasoning and thinking. Applied statistical methods according to SSAA were assessed in term of sex, age, educational level, different majors and universities to make sure we have covered all bases.

To obtain model and modeling, relationship between each cited items were analyzed to guarantee used method and sequential statistics, providing that making optimal benefits to affected populations. Regression and path analysis as advanced analysis were used to obtain accurate results.

The population of this study included agricultural extension and education master and PhD graduated student, (N = 750) in selected seven university in Iran, of which 315 student was selected that appraisal for SSAA. Also 115 graduated students were asked by questionnaires to extract another variable. The research based on the Cochran formula and using stratifies random sampling, questionnaires and checklists. Questionnaires face validity was established by a panel of experts consisting of faculty members and graduate students at Tehran University and Islamic Azad University, Iran. A pilot test was conducted with 25 students in the same field. Questionnaire reliability was estimated by calculating Alfa Cronbach, Ordinal Theta and Compose Reliability methods by spss, R and Lisrel software. Reliability for the overall instrument was estimated at 0.91, 0.93 and 0.90 % respectively. Also, questions that decrease each of above coefficients eliminate.

3. Results

Table 1 shows the Summaries of demographic profile and descriptive statistics. The results of descriptive statistics indicated that most of students were men (51.3%). It was reported that slightly more than 83% of Graduated students had master degree whose maximum level of literacy was PhD. Over 84% of them were studied in agricultural extension and education major. Mean their dissertations and thesis marks were 18.93.

Table 1.Personal characteristics of respondent

Variables	Scale	Measure
Sex	Men	51.3%
Degree	Master	83%
Major	Agricultural extension and education	84%
Thesis score	Mean	18.93

Information regarding the factors of statistical principal component of statistics and methodology learning is recorded in Table 2. As can be seen from this, the lowest coefficient variation refers to the level of teacher perceptions about student statistical problems (CV = 2.891) and the highest coefficient variation refers to use of computer in statistical analysis (CV = 7.829).

Table 2. Ranking of principal component of statistics and methodology learning

Options	Mean	SD	CV	Rank
I am not interested in quantitative methods	4.48	1.393	3.216	4
There is not enough real world application in courses	5.03	1.120	4.491	14
I am not good at mathematics and that is why I am not good at methodology	4.78	1.058	4.517	15
Computers are difficult to use when doing analyses	**5.70**	**0.728**	**7.829**	**17**
The teaching is too superficial	5.23	0.956	5.470	16
The teaching is too hasty: there is no time in the lecture to really get familiar with the subjects	4.19	1.176	3.562	8
Examples used in courses are not interesting	3.98	1.304	3.052	3
Methodology skills are easy to forget, because you do not need them daily	4.03	1.242	3.244	5
The data used in courses are not interesting, because they don't feel real own	4.38	1.105	3.963	12
It is hard to see links between different parts of research methodology	4.30	1.092	3.937	11
Methodological concepts are hard to understand	4.69	1.127	3.161	13
Too many new concepts are introduced too fast during courses	4.53	1.202	3.768	9
Teachers use too difficult language and do not explain things well	4.46	1.333	3.345	6
Teachers do not see and understand students problems	**4.14**	**1.432**	**2.891**	**1**
I have a negative attitude toward methodology studies	4.23	1.447	2.923	2
Methodological books are hard to understand	4.90	1.280	3.828	10
Methodology courses need more work that other courses	4.44	1.306	3.399	7

(0 = nothing; 7 = strongly agree)

In order to finding the statistical analysis content knowledge, respondents were asked to express their views. The result showed that the lowest coefficient variation refers to extension, prediction and explanation of extracted information (CV= 3.767) and highest coefficient variation refers to finding of mean, mod and median (CV= 8.429).

The perception of respondents about the statistical reasoning was displayed in Table 3. The lowest coefficient variation refers to Groups can only be compared if they have the same size (CV = 3.079) and the highest coefficient variation refers to Outcome orientation (CV = 5.681).

Table 3: ranking of student statistical reasoning

options	Mean	SD	CV	Rank
Correct reasoning scale				
Correctly interprets probabilities	4.59	1.13	4.02	11
Understands how to select an appropriate average	4.87	0.86	5.53	15
Correctly computes probability, both understanding probabilities as ration, and using combinatorial reasoning	4.68	1.16	4.01	10
Understands independence	4.76	1.24	3.81	8
Understands sampling variability	5.16	1.10	4.66	13
Distinguishes between correlation and causation	4.94	1.05	4.67	14
Correctly interprets two-way table	4.54	1.21	3.74	7
Understands the importance of large sample	4.85	1.31	3.69	5
Misconception scales				
Misconceptions involving averages	5.11	1.25	4.07	12
Outcome orientation	**5.13**	**0.90**	**5.68**	**16**
Good sample have to represents a high percentage of the population	4.85	1.25	3.85	9
Law of small numbers	5.04	1.57	3.42	3
Representativeness misconception	4.67	1.24	3.74	6
Equiprobability bias	4.92	1.40	3.49	4
Groups can only be compared if they have the same size	**4.01**	**1.30**	**3.07**	**1**

(0 = nothing; 7 = strongly agree)

The perception of respondents about the statistical thinking was displayed in Table 4. The lowest coefficient variation refers to" Evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions "(CV= 3.804) and the highest coefficient variation refers to measurement of univariate (CV= 6.115).

Table 4: ranking of student statistical thinking

Options	Mean	SD	CV	Rank
Understand the differences among various kinds of studies and which type of inferences can legitimately be drawn from each	4.83	0.99	4.83	9
Know the characteristics of well-designed studies, including the role of randomization in surveys and experiments	4.92	0.99	4.95	10
Understand the meaning of measurement data categorical data, of univariate and bivariate data, and of the term variable	5.06	0.89	5.67	12
Understanding histograms, box plots, and scatter plots and use them to display data	4.93	0.96	5.12	11
Compute basic statistics and understand the distinction between a statistic and a parameter	4.80	1.12	4.26	5
For univariate measurement data, be able to display the distribution , describe its shape, and select and calculate summary statistics	**5.95**	**0.97**	**6.11**	**13**
For bivariate measurement data, be able to display a scatter plot, describe its shape and determine regression coefficients, regression equations, and select and calculate summary statistics	4.90	1.09	4.47	8
Recognize how linear transformation of univariate data affect shape center, and spread	4.95	1.13	4.34	6
Identify trends in bivariate data find functions that model the data or transform the data so that they can be modeled	4.92	1.20	4.10	4
Use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions	5.04	1.31	3.83	2
Understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference	4.84	1.19	4.04	3
Evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions	**4.93**	**1.29**	**3.80**	**1**
Understand how basic statistical techniques are used to monitor process characteristics in the workplace	5.10	1.16	4.38	7

(0 = nothing; 7 = strongly agree)

Also, the perception of respondents about the statistical perception and attitude showed that the lowest coefficient variation refers to negative sense about statistics (C= 1.863) and the highest coefficient variation refers to benefit and suit of statistics in professional life (CV = 6.696).

Correlation between variables:

Spearman coefficient was employed for measurement of relationships between the applying proper statistical methods and statistical literacy, reasoning, thinking, perception and several phases of SSAA and graduated student demographic characteristics. Table 5 shows the results which show that there were relationships between apply proper statistical methods and level of study, statistical literacy, reasoning, thinking and attitude. Spearman coefficient was also employed for measurement of relationships between the statistical literacy, reasoning, thinking and different phases of SSAA. Table 5 shows that there were significant relationship between independent variables and dependent variable except for three statements.

Table 5: Correlation measures between independent variables and Applying statistical methods

First variable	Second variable	r	Sig
Statistical literacy (first level) (DD1)	APSM (B)	0.391**	0.00
Statistical literacy (second level) (DD2)	APSM (B)	0.495**	0.00
Statistical literacy (tertiary level) (DD3)	APSM (B)	0.474**	0.00
Statistical literacy (fourth level) (DD4)	APSM (B)	0.394**	0.00
statistical reasoning (C)	APSM (B)	0.617**	0.00
Statistical thinking (F)	APSM (B)	0.273**	0.003
Statistical attitude (E)	APSM (B)	0.591**	0.00
Principal component of learning (A)	APSM (B)	0.394**	0.00
First phase of SSAA (X14)	APSM (B)	-0.229*	0.014
Second phase of SSAA (X15)	APSM (B)	-0.128*	0.049
Tertiary phase of SSAA (X16)	APSM (B)	-0.326**	0.000

*: $p<0.05$; **: $p<0.01$

(B) Applying statistical methods as dependent variable, (C) Statistical reasoning, (DD1) Statistical literacy (level 1), (DD3) Statistical literacy (level 3), (E) Statistical attitude , (F) Statistical thinking , (X14) Initial phases of SSAA, (X15) Intermediate phases of SSAA, (X16) Advanced phases of SSAA

Regression analysis:

Table 6 shows the result for regression analysis by stepwise method. Independent variables that were significantly related to the applying proper statistical methods were subjected to regression analysis. The result indicates that 66% of the variance in the applying proper statistical methods could be explained by two variables of statistical reasoning and statistical attitude.

Table 6: Multivariate Regression Analysis (applying proper statistical methods as dependent variable)

	B	Beta	T	Sig
Constant	-0.24		-0.09	0.92
Statistical reasoning	0.41	0.52	7.93	0.00
Statistical attitude	0.43	0.35	5.04	0.00

$R^2 = 0.66$

Path analysis:

By using Lisrel 8.5 software, path analysis has been done to know the direct and indirect effect of all significant independent variables on dependent variable. Result extracted from path analysis shows that statistical attitude had maximum total effect (direct and indirect effect) on applying statistical methods as dependent variable (Table 7). This mean the weight of statistical attitude to determine dependent variable variance is 0/80, also model fit range from acceptable to weak(RMSEA) (X2/df ratio and p- value) to good (CFI, GFI, AGFI and NFI (Table 8 and Fig. 4).

Table 7- direct, indirect and total effect in path analysis

Paths	Direct	Indirect	Total
From statistical reasoning to applying statistical methods C → B	0.36	-	0.36
From statistical attitude to applying statistical methods E → B	0.66	0.15	0.81
From statistical literacy (level 1) to applying statistical methods DD1 → B	0.49	-	0.49
From statistical literacy (level **3**) to applying statistical methods DD**3** → B	0.80	-	0.80
From statistical thinking to applying statistical methods F → B	-	0.27	0.27
From first phase of SSAA to applying statistical methods X14 → B		-0.32	-0.32
From second phase of SSAA to applying statistical methods X15 → B	-0.34	-0.08	-.42
From third phase of SSAA to applying statistical methods X16 → B	0.41	-	041

Table 8: Suitability indicators in path analysis applying proper statistical methods

Goodness of fit test	Amount
Normal theory weighted least squares chi-square	38.92
P-value	0.020
Degrees of freedom	23
Root Mean Square Error of Approximation (RMSEA)	0.080
Comparative Fit Index (CFI)	0.98
Normal Fit Index (NFI)	0.95
Goodness of Fit Index (GFI)	0.94
Adjusted Goodness of Fit Index (AGFI)	0.85

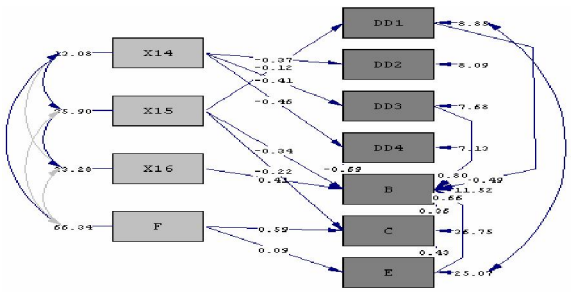

Figure 4: path diagram of direct and indirect effects of independent variable on applying statistical methods

4. Discussions

This paper is intended to be a concise guide for choosing a statistical test with regard to notions extracted from SSAA and statistical literacy, reasoning and thinking. It can use for educational assessment, interpreting and analyzing educational studies without relying on mathematical theories. To provide a framework for understanding statistical concepts and to illustrate the decision-making process to choose a statistical test, we've presented an educational intervention detailing the hypothesis testing, data analysis, and interpreting the results. All notions have shown as a model like figure 4. In this model, each phases of SSAA become meaningful through the components of statistical literacy. Initial phase is recognized as statistical literacy that can be matched with hidden concepts on it. Intermediate phase can be matched with literacy reasoning (Figure 4).

The findings have shown that the students had used statistical phases in regard to their domination on each level of statistical literacy, reasoning and thinking. Meanwhile, applying this roadmap could improve their statistical knowledge. Considering and using sequential statistics by agricultural extension and education students, could give them a general view to exploit from mixed statistical tests. Student could see statistical test in the system and conduct them to understand superior realize from relationship between level and phases and suppose them as group of interrelated, interacting or interdependent elements that forming a complex whole.

Finding synthetic test enable student to refine data and variables. Ultimately, they could extract pure result and knowledge.

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