Journal of Business and Economics, ISSN 2155-7950, USA
May 2014, Volume 5, No. 5, pp. 708-717
DOI: 10.15341/jbe(2155-7950)/05.05.2014/009
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Examining Potential Latent Constructs in Teaching a Business Statistics Course: Clustering Responses from Attitudinal Survey Data

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Abstract: There are many studies on pedagogical research in the area of statistics. Existing research points out an overall negative attitude towards statistics. However, finding new methods that improve student attitudes is not that easy. In this study we use a pretest and posttest survey methodology, then cluster student attitudes via EFA to show that attitudes improve significantly. Students' confidence levels increase and they see statistics more useful. The findings are promising when data driven approach is used but more research has to be conducted to develop a sound theory basis on these results.

Key words: statistics; pedagogy; teaching; learning theory; computer application
JEL codes: A22, M10, C38

1. Literature Review

The problem of student attitudes towards statistics is well documented. Past research has shown that students' ability to learn the material or to develop a mindset of "statistical thinking" may be linked to preconceived or reflective attitudes towards the topic. Gal & Ginsburg indicate that statistics educators routinely mention that many students enter statistics courses with negative views or later develop negative feelings about the domain of statistics (Gal I. & Ginsburg L., 1994). According to Perney & Ravid statistics courses are viewed by most college students as an obstacle standing in the way of attaining their desired degree and that it is not uncommon to see students who delay taking the statistics courses until just before graduation (Perney J. & Ravid R., 1991). They also mention the high level of anxiety exhibited by the students in a statistics course on the first day of the term. Gal & Ginsburg also state that there are strong indicators that students' negative feelings about statistics education, and the effects of these feelings on resulting learning, knowledge and further interest in statistics, should occupy a major role in the minds of statistics educators (Gal I. & Ginsburg L., 1994). According to Gal, Ginsburg & Schau statistics educators should know their students' attitudes and beliefs towards statistics before, during and after taking a statistics course (Gal I., Ginsburg L. & Schau C., 1997). However, as Gal & Ginsburg point out since

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statistics is a quantitative subject, transmitting the mathematical knowledge can often be the only focus in instruction ignoring the non-cognitive factors (Gal I. & Ginsburg L., 1994).

According to many research papers student attitude is an important determinant for learning statistics. The effect of non-cognitive factors such as attitudes on learning statistics has been well documented (Gal I. & Garfield J. B., 1997; Gal I. & Ginsburg L., 1994; Gal I., Ginsburg L. & Schau C., 1997; Shaughnessy M. J., 1992). These studies have shown that non-cognitive factors impede learning, hinder development of useful statistical intuition, and hinder application of knowledge outside of the classroom. According to Gal, Ginsburg & Schau and Gal & Garfield students' attitudes may affect their level of statistical thinking skills that they need in and outside the classroom (Gal I. & Garfield J. B., 1997; Gal I., Ginsburg L. & Schau C., 1997). Therefore, it is very important to study the students' attitudes students toward statistics and the relationship between these attitudes and students' performance in statistics.

Schau et al. and Garfield & Gal demonstrate that positive attitudes correlate with positive outcomes in statistics courses (Garfield J. & Gal I., 1999; Schau C., Stevens J., Dauphinee T. L. & Del Vecchio A., 1995). Vanhoof et al. also show that there is a positive relationship between students' attitudes toward the use of statistics in their field of study and their course performance. Furthermore Vanhoof et al. found that the relationship between attitudes toward statistics and exam results is content-specific, which is they did not find a relationship between attitudes and general exam results, only between attitudes and results on statistics exams (Vanhoof S., Sotos A. E. C., Onghena P., Verschaffel L., van Dooren W. & Van den Noortgate W., 2006). This also indicates that student attitude is especially important in learning statistics compared to other subjects. However, there is no clear protocol on how to develop a positive attitude besides simplifying the pedagogy or implementing some form of grade inflation.

According to Yilmaz ability to link real-world situations in the classroom is a key factor to teaching statistics (Yilmaz M. R., 1996). This approach keeps students engaged which improves their attitudes towards the course and towards the statistics. Carnell investigated whether a student-designed a hands-on data collection project yields more positive attitude toward statistics and finds no significant impact students' attitudes toward statistics with inclusion of a hands-on project (Carnell L. J., 2008).

Suanpang et al. compared online (E-learning) and traditional methods and they found that significant differences exist in student attitudes towards to learning business statistics between the different modes of learning (Suanpang P., Petocz P. & Kalceff W., 2004). They concluded that students who are taught online develop strongly positive attitudes towards learning statistics, which influence their learning and make understanding statistics easier for them than for students taught in the traditional mode. There are also studies that compare computer assisted instruction and the traditional method of teaching such as Ragasa and Shaltayev et al. (Ragasa, C. Y., 2008; Shaltayev D., Hodges H. & Hasbrouck R. B., 2010). Ragasa compared computer assisted instruction (CAI) and traditional instruction (Ragasa, C. Y., 2008). In the results of this limited study it is observed the combination of computer-assisted instruction and collaborative work improves learning without a significant effect on attitude. Shaltayev et al. found no evidence that technology availability in classroom improves students' course performance if statistics software is used for teaching statistics (Shaltayev D., Hodges H. & Hasbrouck R. B., 2010). Although the results are both limited and mixed, the use of office automation or computerized programs has shown to provide some progress in bridging the attitude gap.

The ability to use technology to teach statistics has significantly decreased the time to calculate the formulae

used in both descriptive and inferential statistics. This has opened the opportunity to explore new approaches in teaching statistics. Traditionally, course pedagogy focuses on individual procedures, calculations and outputs. The problems and outcome are partitioned by chapter and do not allow the student to digest the larger landscape of using these procedures as part of a data analysis collection. Given the chapter-to-chapter focus of traditional pedagogical approaches it would be a stretch for a student to be able to properly identify, classify and solve a real-world problem without know what statistical procedure to use a priori.

Keller and Warrack introduced one of the first flowcharts for identifying the proper procedure of statistical inference (Keller G. & Warrack B., 2003). This work, along with the use of a statistical software program, has been the motivation for the authors to develop an applied, data driven approach in our undergraduate business statistics courses. However for those that use a statistical software program in the classroom, we have found that students can have trouble learning these programs and can easily get frustrated while trying to solve problems both inside and outside of the classroom. The selection of a software package that is both easy to learn and provides the output necessary to cover the important pedagogical learning points of the course is an individual preference and is best learned on a trail-and-error process. An example of one such experience can be found in Shaltayev et al. (Shaltayev D., Hodges H. & Hasbrouck R. B., 2010)

The data analysis approach to teaching statistics aims to educate students on the use and meaning of data rather than the more traditional computational approach that absorbs a significant amount of time tackling the mathematical handling of the problem. Not that this is not an important aspect of learning, but in a business environment where the nomenclature of a board room or meeting is more interested in the meaning of the results as well as the bottom line implications.

When teaching statistics using a data analysis approach there are five steps we emphasize: what is the data type (quantitative, ordinal or nominal) how is the data presented (number of populations and experimental design) are we seeking to determine a difference or a relationship in this problem? Based on the three answers above what is the appropriate statistical procedure to use (this step involves testing quantitative data for normality) and what is the business decision based on the results?

The last question involves the use of a software package or add-in that can provide the appropriate p-value. Embedded into this pedagogy is a strong understanding of the hypothesis test. This procedure is taught using both mathematical terms and is also expressed in conceptual terms so that one could report the findings in a board meeting where the knowledge of the attendees usually lacks fluency in statistics or has the ability to recall of all of the mathematical terms and concepts of inferential statistics.

Over the years we have collected survey data in our courses concerning student attitudes, pre-test and post-test, towards statistics. Our data is from two different universities with AACSB accredited business programs. Periodically we have examined this data to see what, if any, changes occur when comparing the pre-test vs. post-test surveys using a paired t-test. However, the latent or construct variables that exist behind student responses have yet to be explored.

2. Methodology and Results

Using the data analysis approach to teaching statistics has shown that students reflect a higher positive attitude towards statistics (Deniz B., Hasbrouck R. B. & Hodges H., 2011). However, the latency of this

improvement is not fully understood. Specifically, the following research questions have been formulated;

(1) What are the underlying latent factors that capture the preconceptions on how students view business statistics?

(2) Upon completion of the course how do the latent factors change when compared to the pretest results?

(3) What changes in the composition/size of the factor clusters occur from the pretest to the posttest?

(4) Does the direction of the responses change (negative to positive, positive to negative) when comparing the pretest to the posttest factor clusters?

To examine the attitudes of statistics students in an undergraduate setting, 109 pretest and 94 posttest usable surveys were conducted from a sophomore-level business statistics course at two AACSB accredited institutions. At both universities, the course is the second of two required statistics courses with the first being taught in the Mathematics department and the second in the School of Business. The survey used was from Wise which captures both attitudes about the topic as well as the field of statistics (Wise S. L., 1985). The survey was administered during the first day of class (pretest) and again during the last week of classes or during the final exam (posttest). The survey contained all 29 questions from the Wise survey along with 11 additional questions that captured gender, grade expectations, study habits, work hours and other related questions. This study focused only on the 29 questions that relate to the course and profession.

To better understand the latent underpinnings of student attitudes an exploratory factor analysis (EFA) approach was used to compare the pretest and posttest results for commonalities and differences. The Wise survey provides Likert scaling which is excellent for social research methods such as EFA. Furthermore, the Wise survey includes a wide range of questions that examine the pedagogical topic of statistics as well as the applied and practical use of statistics in both industry and everyday life.

3. Results

3.1 Pretest

The Varimax procedure using SPSS® software was applied to determine the pretest and posttest results. Only the 29 questions related to student attitudes were examined to determine if there were any latent correlations. The additional 11 questions were omitted and may be included for future research (see discussion section). Factors with an eigenvalue of at least one and a factor loading of at least 0.50 were retained.

Five factors were derived from the pretest results. The factor groupings, survey questions and individual loadings are shown in Table 1.

The results of the exploratory factor analysis show seven factors that explain approximately 64.6% of the variation. Each of the factor groupings represented a mix of questions from the field as well as the topical issues of statistics.

Table 2 provides the means from each of the question responses. The means are based on a 5-point scale with 5 representing Strongly Agree to Strongly Disagree and the response values were reversed for negative-based survey statements.

The majority of the response means is at 3.0 or below and indicates a level of indifference or negativity towards statistics. This result is reflected in the responses regardless if they are related to the field or to the profession of statistics.

Table 1 Pretest Factor Loadings

Factor 1	**Emotional Bias**	
12	I wish that I could have avoided taking my statistics course.	0.850
7	I see being enrolled in a statistics course as a very unpleasant experience.	0.850
15	I get upset at the thought of enrolling in another statistics course.	0.746
2	The thought of being enrolled in a statistics course makes me nervous.	0.738
27	Statistics is too complicated for me to use effectively	0.705
4	Statistics seems very mysterious to me.	0.654
8	I would like to continue my statistical training in an advanced course.	-0.517
19	I am excited at the prospect of actually using statistics in my job.	-0.627
Factor 2	**Academic Value**	
10	Statistics is not really very useful because it tells us what we already know anyway.	0.692
28	Statistics training is not really useful for most professionals.	0.598
9	Statistics will be useful to me in comparing the relative merits of different objects; methods; programs; etc.	0.571
5	Most people would benefit from taking a statistics course.	-0.513
24	Statistics thinking can play a useful role in everyday life.	-0.562
20	Studying statistics is a waste of time.	-0.680
Factor 3	**Career Development**	
11	Statistics training is relevant to my performance in my field of study.	0.726
6	I have difficulty seeing how statistics relates to my field of study.	0.796
1	I feel that statistics will be useful to be in my profession	-0.570
Factor 4	**Quantitative Skill**	
25	Dealing with numbers makes me uneasy	0.760
14	Statistics is too much oriented to be of much use to me in the future.	0.820
18	I feel intimidated when I have to deal with mathematical formulas	0.577
Factor 5	**Utilitarian Commonality**	
29	Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write	0.663
26	I feel that statistics should be required early in one's professional training.	0.621
Factor 6	**Personal and Professional Application**	
22	One becomes a more effective "consumer" of research findings if one has some training in statistics.	0.791
21	My Statistical training will help me better understand the research being done in my field of study.	0.545
Factor 7	**Scientific/Academic Value**	
17	Statistics is an inseparable aspect of scientific research.	0.769

3.2 Post Test

The posttest was administered during the last week of the 16-week semester. The results for the factor loadings generated the same number of factors and explained 58.6% of the variance. The results from the posttest are listed in Table 3.

Table 2 Pretest Means

Question	Mean	S.d.	n
I fell that statistics will be useful to me in my profession	3.82	0.830	109
The thought of being enrolled in a statistics course makes me nervous.	2.98	1.114	109
A good researcher must have training in statistics.	4.13	0.708	109
Statistics seems very mysterious to me.	2.66	1.020	109
Most people would benefit from taking a statistics course.	3.77	0.662	109
I have difficult seeing how statistics relates to my field of study.	2.31	0.868	109
I see being enrolled in a statistics course as a very unpleasant experience.	2.76	1.026	109
I would like to continue my statistical training in an advanced course.	2.48	0.777	109
Statistics will be useful to me in comparing the relative merits of different objects; methods; programs; etc.	3.74	0.725	109
Statistics is not really very useful because it tells us what we already know anyway.	2.01	0.616	109
Statistics training is relevant to my performance in my field of study.	3.57	0.821	109
I wish that I could have avoided taking my statistics course.	2.92	1.107	109
Statistics is a worthwhile part of my professional training.	3.66	0.670	109
Statistics is too math oriented to be of much use to me in the future.	2.22	0.774	109
I get upset at the thought of enrolling in another statistics course.	2.81	1.032	109
Statistics analysis is best left to the “expects” and should not be part of a lay professional’s job.	2.39	0.744	109
Statistics is an inseparable aspect of scientific research.	3.81	0.787	109
I feel intimidated when I have to deal with mathematical formulas	2.41	1.065	109
I am excited at the prospect of actually using statistics in my job.	2.87	0.818	109
Studying statistics is a waste of time.	2.03	0.552	109
My statistical training will help me better understand the research being done in my field of study.	3.71	0.698	109
One becomes a more effective “consumer” of research findings if one has some training in statistics.	3.79	0.639	109
Training in statistics makes for a more well-rounded professional experience.	3.81	0.569	109
Statistical thinking can play a useful role in everyday life.	3.74	0.763	109
Dealing with numbers makes me uneasy.	2.25	1.098	109
I feel that statistics should be required early in one’s professional training.	3.33	0.782	109
Statistics is too complicated for me to use effectively.	2.44	0.865	109
Statistical training is not really useful for most professionals.	2.38	0.704	109
Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.	2.50	0.959	109

Note: a. Only cases for which test = Pretest are used in the analysis phase.

The results from the means also produced different results from the pretest. Many of the averages improved, which indicate a more positive and/or confident feeling about the course and profession. The means summary is presented in Table 4.

3.3 Pre vs. Posttest Means

The questions from the pretest were compared to the posttest to examine any significant changes in the individual survey questions using the Wilcoxon Signed Ranks Test procedure for independent samples. Also, the changes were examined to determine if the comparison could provide further insights on the factor analysis

groupings. The results of the two surveys were compared to determine any significant differences between the response means. The results are presented in Table 5 (bolded questions are significant using $\alpha \leq 0.10$).

Table 3 Posttest Factor Loadings

Factor 1	**Statistical Acumen**	
21	My statistical training will help me better understand the research being done in my field of study.	0.775
11	Statistical training is relevant to my performance in my field of study.	0.771
9	Statistics will be useful to me in comparing the relative merits of different objects; methods; programs; etc.	0.645
1	I feel that statistics will be useful to me in my profession	0.620
13	Statistics is a worthwhile part of my professional training.	0.606
5	Most people would benefit from taking a statistics course.	0.596
24	Statistical thinking can play a useful role in everyday life.	0.539
23	Training is statistics makes for a more well-rounded professional experience.	0.531
26	I feel that statistics should be required early in one's professional training.	0.516
22	One becomes a more effective "consumer" of research findings if one has some training in statistics.	0.504
16	Statistical analysis is best left to the "expects" and should not be part of a lay professional's job.	-0.655
20	Studying statistics is a waste of time.	-0.685
6	I have difficulty seeing how statistics relates to my field of study.	-0.767
Factor 2	**Utilitarian Value**	
29	Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.	0.703
8	I would like to continue my statistical training in an advanced course.	0.676
19	I am excited at the prospect of actually using statistics in my job.	0.556
15	I get upset at the thought of enrolling in another statistics course.	-0.639
12	I wish that I could have avoided taking my statistics course.	-0.722
7	I seeing being enrolled in a statistics course as a very unpleasant experience.	-0.730
Factor 3	**Data Analysis Skill**	
18	I feel intimidated when I have to deal with mathematical formulas.	0.836
25	Dealing with numbers makes me uneasy.	0.833
4	Statistics seems very mysterious to me.	0.705
27	Statistics is too complicated for me to use effectively.	0.635
2	The thought of being enrolled in a statistics course makes me nervous.	0.572
Factor 4	**Quantitative Skill**	
14	Statistics is too math oriented to be of much use to me in the future.	0.757
10	Statistics is not really very useful because it tells us what we already know anyway.	0.716
28	Statistical training is not really useful for most professionals.	0.640
Factor 5	**Scientific/Academic Value**	
17	Statistics is an inseparable aspect of scientific research.	0.780
3	A good researcher must have training in statistics.	0.701

Table 4 Posttest Means

Question	Mean	s.d.	n
I fell that statistics will be useful to me in my profession.	3.98	1.037	94
The thought of being enrolled in a statistics course makes me nervous.	2.88	1.181	94
A good researcher must have training in statistics.	4.34	0.597	94
Statistics seems very mysterious to me.	2.36	0.993	94
Most people would benefit from taking a statistics course.	3.93	0.858	94
I have difficult seeing how statistics relates to my field of study.	2.20	0.946	94
I see being enrolled in a statistics course as a very unpleasant experience.	2.88	1.190	94
I would like to continue my statistical training in an advanced course.	2.57	1.122	94
Statistics will be useful to me in comparing the relative merits of different objects; methods; programs; etc.	3.93	0.793	94
Statistics is not really very useful because it tells us what we already know anyway.	1.86	0.712	94
Statistics training is relevant to my performance in my field of study.	3.70	1.004	94
I wish that I could have avoided taking my statistics course.	2.86	1.275	94
Statistics is a worthwhile part of my professional training.	3.73	0.894	94
Statistics is too math oriented to be of much use to me in the future.	2.04	0.854	94
I get upset at the thought of enrolling in another statistics course.	2.99	1.205	94
Statistics analysis is best left to the “expects” and should not be part of a lay professional’s job.	2.45	0.899	94
Statistics is an inseparable aspect of scientific research.	3.82	0.803	94
I feel intimidated when I have to deal with mathematical formulas	2.39	1.138	94
I am excited at the prospect of actually using statistics in my job.	3.12	1.046	94
Studying statistics is a waste of time.	1.97	0.809	94
My statistical training will help me better understand the research being done in my field of study.	3.89	0.769	94
One becomes a more effective “consumer” of research findings if one has some training in statistics.	4.01	0.664	94
Training in statistics makes for a more well-rounded professional experience.	4.11	0.595	94
Statistical thinking can play a useful role in everyday life.	3.85	0.761	94
Dealing with numbers makes me uneasy.	2.22	1.128	94
I feel that statistics should be required early in one’s professional training.	3.51	0.813	94
Statistics is too complicated for me to use effectively.	2.21	0.890	94
Statistical training is not really useful for most professionals.	2.26	0.891	94
Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.	2.37	0.892	94

Note: a. Only cases for which test = Posttest are used in the analysis phase.

Table 5 Mean Ranked Comparisons Using the Wilcoxon Signed Ranked Test

Question	Z	Asymp. Sig. (2-tailed)
The thought of being enrolled in a statistics course makes me nervous.	-5.655b	0.000
One becomes a more effective “consumer” of research findings if one has some training in statistics.	-2.903b	0.004
I am excited at the prospect of actually using statistics in my job.	-2.529b	0.011
Training in statistics makes for a more well-rounded professional experience.	-2.328b	0.020
My statistical training will help me better understand the research being done in my field of study.	-2.143b	0.032
Statistics is too complicated for me to use effectively.	-2.051c	0.040
Statistics is too math oriented to be of much use to me in the future.	-2.000c	0.046
Statistics seems very mysterious to me.	-1.985c	0.047
Statistical training is relevant to my performance in my field of study.	-1.932b	0.053
Most people would benefit from taking a statistics course.	-1.873b	0.061
A good researcher must have training in statistics.	-1.542b	0.123

(Table 5 continued)

Question	Z	Asymp. Sig. (2-tailed)
I would like to continue my statistical training in an advanced course.	-1.481b	0.139
Statistics will be useful to me in comparing the relative merits of different objects; methods; programs; etc.	-1.328b	0.184
Statistics is not really very useful because it tells us what we already know anyway.	-1.262c	0.207
Studying statistics is a waste of time.	-1.215c	0.224
I wish that I could have avoided taking my statistics course.	-1.164c	0.245
Statistical training is not really useful for most professionals.	-1.161c	0.246
I feel that statistics will be useful to me in my profession.	-1.095b	0.274
Statistical thinking can play a useful role in everyday life.	-1.006b	0.314
I feel that statistics should be required early in one's professional training.	-1.004b	0.315
Statistics is a worthwhile part of my professional training.	-0.895b	0.371
I have difficulty seeing how statistics relates to my field of study.	-0.826c	0.409
I get upset at the thought of enrolling in another statistics course.	-0.704b	0.482
I feel intimidated when I have to deal with mathematical formulas.	-0.450c	0.653
Statistics is an inseparable aspect of scientific research.	-0.330b	0.741
Dealing with numbers makes me uneasy.	-0.259c	0.796
Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.	-0.158b	0.874
I see being enrolled in a statistics course as a very unpleasant experience.	-0.123c	0.902
Statistical analysis is best left to the "expects" and should not be part of a lay professional's job.	-0.021b	0.983

Note: a. Wilcoxon Signed Ranked Test; b. Based on negative ranks; c. Based on positive ranks.

4. Discussion

The initial clustering of the pretest indicates a negative and apprehensive attitude towards the course and the profession. In general, the students felt the course was not beneficial to their personal learning or to their future professions. A noted lack of quantitative/mathematical skills was also found. However, the need for scientific research was regarded as important and this question was a unique outlier to all of the other factors. The biggest cluster of the seven latent variables clearly centered on the lack of understanding and fear of the course itself. The lack of statistical thinking (understanding) has been well cited in past research so it is of no surprise to find this the largest factor in the pretest group. Clearly, a student's experience prior to entering a business statistics course is wrought with difficult and negative events.

The posttest results both reshuffled and reduced the number of latent variables. The results also indicate a more confident or positive view of the course and of the field in general. The largest of the five factors, Statistical Acumen, shows a stark contrast to the Emotional Dissonance variable found in the pretest. Students also found value in the use of statistics in both personal and professional endeavors. The shift between the pretest and posttest also shows a much lower level of trepidation towards math and statistical tasks. The pedagogy of teaching a course using a data-based approach is to focus on the business problem and to use a statistical software package to interpret the solution. This process is an applied approach that is used in research and industry today. It also appears to provide confidence and relevance to the role of inferential statistics in solving problems.

The means test found several significant changes in the responses. The attitudes towards nervousness mystery and complicated nature of statistics significantly improved. Also, the professional value of statistics improved. These findings offer some hope in solving the trepidation and bias that has plagued our profession both in and out of the classroom.

5. Conclusions and Future Research

The results of this study provide promise that the use of a data analysis approach may provide a more appropriate result for business students who need the requisite skills to make objective decisions in their future field or endeavor into industry. We would argue that this approach also supports the pedagogical procedures that are used in case-based MBA programs.

Future research in this area would benefit from the development of a theoretical model that captures the latent variables from a larger study. We would also argue that a more exhaustive approach be used to determine the best constructs as well as the most robust survey items that should be used to capture this information. Additional information such as demographic data such as gender, class standing, prior math experience, etc. should be considered and thoroughly examined for additional latent relationships. Furthermore, other surveys exist such as SATS-36 could provide a more robust insight on the underlying constructs that leverage student attitudes towards the discipline (Schau C., Stevens J., Dauphinee T. L. & Del Vecchio A., 1995).

References:

Carnell L. J. (2008). "The effect of a student-designed data collection project on attitudes toward statistics", *Journal of Statistics Education*, Vol. 16, No. 1.

Deniz B., Hasbrouck R. B. and Hodges H. (2011). "Student attitudes toward business statistics: Comparison of data analysis approach vs. traditional approach", in: *Northeastern Decision Sciences Institute Annual Meeting*, Montreal, Canada.

Gal I and Garfield J. B. (Eds.) (1997). *The Assessment Challenge in Statistics Education*, Amsterdam: IOS Press.

Gal I. and Ginsburg L. (1994). "The role of beliefs and attitudes in learning statistics: Towards an assessment framework", *Journal of Statistics Education*, Vol. 2, No. 2.

Gal I., Ginsburg L. and Schau C. (1997). "Monitoring attitudes and beliefs in statistics education", in: I. Gal, & J. B. Garfield (Eds.), *The Assessment Challenge in Statistics Education*, Netherlands: IOS Press, pp. 37-51.

Garfield J. and Gal I. (1999). "Teaching and assessing statistical reasoning", in: L. Stiff (Ed.), *Developing Mathematical Reasoning in Grades K-12*, Reston, VA: National Council Teachers of Mathematics, pp. 207-219.

Keller G. and Warrack B. (2003). *Statistics for Management and Economics*, Brooks/Cole –Thomson Learning, Pacific Grove, CA.

Perney J. and Ravid R. (1991). "The relationship between attitudes towards statistics, math self-concept, test anxiety and graduate students' achievement in an introductory statistics course", unpublished manuscript, National College of Education, Evanston, IL.

Ragasa C. Y. (2008). "A comparison of computer-assisted instruction and the traditional method of teaching basic statistics", *Journal of Statistics Education*, Vol. 16, No. 1.

Roberts D. M. and Bilderback E. W. (1980). "Reliability and validity of a statistics attitude survey", *Educational and Psychological Measurement*, Vol. 40, pp. 235-238.

Schau C., Stevens J., Dauphinee T. L. and Del Vecchio A. (1995). "The development and validation of the survey of attitudes toward statistics", *Educational and Psychological Measurement*, Vol. 55, No. 5, pp. 868-875.

Shaltayev D., Hodges H. and Hasbrouck R. B. (2010). "VISA: Reducing Technological impact on student learning in an introductory statistics course", *Technology Innovations in Statistics Education*, Vol. 4, No. 1.

Shaughnessy M. J. (1992). "Research in probability and statistics: Reflections and directions", in: D. A. Grouws (Ed.), *Handbook of Research on Mathematics Teaching and Learning*, NY: Macmillan, pp. 465-494.

Suanpang P., Petocz P. and Kalceff W. (2004). "Student Attitudes to learning business statistics: Comparison of online and traditional methods", *Educational Technology & Society*, Vol. 7, No. 3, pp. 9-20.

Vanhoof S., Sotos A. E. C., Onghena P., Verschaffel L., van Dooren W. and Van den Noortgate W. (2006). "Attitudes toward statistics and their relationship with short- and long-term exam results", *Journal of Statistics Education*, Vol. 14, No. 3.

Wise S. L. (1985). "The development and validation of a scale measuring attitudes toward statistics", *Educational and Psychological Measurements*, Vol. 45, pp. 401-405.

Yilmaz M. R. (1996). "The challenge of teaching statistics to non-specialists", *Journal of Statistics Education*, Vol. 4, No. 1.