BAREKENG: Journal of Mathematics and Its Applications
September 2024 Volume 18 Issue 3 Page 1975–1988
P-ISSN: 1978-7227 E-ISSN: 2615-3017
https://doi.org/10.30598/barekengvol18iss3pp1975-1988

CORRESPONDENCE ANALYSIS ON STATISTICAL LITERACY AND GENDER: EMBEDDING E-CAMPUS PLATFORM WITH RANDOM ASSIGNMENT OF MATCHED SUBJECT IN EXPLANATORY ANALYSIS

Karunia Eka Lestari [1*], Risnawita[2], Mokhammad Ridwan Yudhanegara[3], Edwin Setiawan Nugraha[4], Sisilia Sylviani[5]

[1,3]Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Singaperbangsa Karawang, Jl. H. S. Ronggowaluyo Teluk Jambe Timur, Karawang, 41361, Indonesia

[2]Department of Mathematics Education, Faculty of Tarbiyah and Teacher Training, UIN Sjeh M. Djamil Djambek, Jl. Gurun Aua Kubang Putiah, Bukittinggi, 26181, Indonesia

[4]Department of Actuarial Science, Faculty of Business, President University Jl. Ki Hajar Dewantara, Bekasi, 17550, Indonesia

[5]Department of Mathematics, Faculty of Mathematics and Natural Science, Universitas Padjajaran Jl. Ir. Soekarno km 21, Sumedang, 45363, Indonesia

*Corresponding author's e-mail: * **karunia@staff.unsika.ac.id***

ABSTRACT

Article History:

Received: 17th March 2024
Revised: 3rd May 2024
Accepted: 18th July 2024
Published: 1st September 2024

Keywords:

Correspondence Analysis;
E-campus Platform;
Gender;
Random Assignment;
Statistical Literacy

This study aims to evaluate the embedding of e-campus platforms during the pandemic in dealing with gender disparities in statistical literacy and shed light on the association structure between statistical literacy and gender disparities. A mixed methods approach with sequential explanatory analysis was performed among 42 pairs (man-woman) sample of sophomore students enrolled in the Inferential Statistics course selected from a random assignment of matched subjects. The two main instruments, the placement test, and the statistical literacy test, were analyzed quantitatively using the Mann-Whitney test and correspondence analysis, followed by qualitative analysis using image and text analysis. The findings reveal that the e-campus platform has increased women's statistical literacy. Specifically, there is a statistically significant difference (1) between men's and women's statistical literacy scores, (2) an association between statistical literacy level and gender, and (3) different tendencies between men's and women's statistical literacy in various ways. The e-campus platform is an excellent solution for the teaching and learning process during the COVID-19 pandemic and beyond. Likewise, it can overcome gender disparities in literacy statistics. Since these findings lead to a higher statistical literacy rate for women than men, this could break the stereotype that women are less statistically literate than men.

How to cite this article:

K. E. Lestari, Risnawita, M. R. Yudhanegara, E. S. Nugraha and S. Sylviani, "CORRESPONDENCE ANALYSIS ON STATISTICAL LITERACY AND GENDER: EMBEDDING E-CAMPUS PLATFORM WITH RANDOM ASSIGNMENT OF MATCHED SUBJECT IN EXPLANATORY ANALYSIS," *BAREKENG: J. Math. & App.*, vol. 18, iss. 3, pp. 1975-1988, September, 2024.

Journal homepage: *https://ojs3.unpatti.ac.id/index.php/barekeng/*
Journal e-mail: *barekeng.math@yahoo.com; barekeng.journal@mail.unpatti.ac.id*

Research Article · Open Access

1. INTRODUCTION

The COVID-19 pandemic has brought unprecedented challenges and changes to the education system worldwide. Higher education institutions were closed due to social distancing and curbing the spread of the virus. Hence, millions of students worldwide were forced to study from home. Despite the disruption due to the pandemic, the shift to e-learning has allowed universities to continue providing education to students. Lecturers and students must use digital platforms to continue teaching and learning activities [1].

The e-campus platform has emerged as an essential tool for education during the COVID-19 pandemic, providing access to a virtual learning environment. This platform allows lecturers to deliver lessons, assignments, and assessments to students through online classes [2]. On the other hand, the transition to an e-campus platform poses several challenges for lecturers and students. Apart from difficulties adapting to new teaching and learning strategies, reduced social interaction, and limited access to digital resources, one of the main concerns is the potential for exacerbating gender disparities.

The gender disparities phenomenon occurs in mathematics and statistics. Several researchers have shown that women face significant barriers to career advancement and are un-deputized in some areas of mathematics, including pure mathematics, theoretical statistics, computer science, and data science [3]–[7]. According to the American Statistical Association, the women workforce in statistics-related fields comprises only 28,3% [8]. It implies an unequal distribution of resources, opportunities, and power by gender. One crucial issue that has received much attention in recent years is the association between gender disparities and levels of statistical literacy [9] [10].

Statistical literacy (SL) has become a fundamental skill for today's data-driven world since critical decisions are made based on available [11]. SL refers to reading, understanding, and interpreting statistical information. It involves data interpretation, presentation, and critical thinking skills. Gal [12] states that SL involves critically evaluating statistics' relevance, accuracy, and reliability and using this knowledge to communicate findings to others effectively. In higher education, SL enables students to understand, interpret, and analyze data and make decisions based on statistical evidence [13], [14]. One can make decisions based on data-driven insights by understanding statistical concepts and methods [15]. In working life, employees must be able to understand and interpret data presented in various formats, such as graphs, charts, and tables. They must also be able to communicate statistical information to others clearly and concisely. Thus, SL becomes an essential skill for employees to be competitive in the labor market of Industry 4.0 [16]. Therefore, mastering SL can expose new career opportunities [17].

As data becomes increasingly available, SLbecomes even more critical because of the need for evidence-based decision-making. Therefore, higher education institutions must ensure that their curricula equip students with statistical knowledge and skills [18]. Students must understand statistical concepts such as probability, sampling, and inference to analyze data and draw meaningful conclusions to become informed decision-makers in their future careers [19]. It suggests the importance of SL for students (regardless of gender) in higher education and work life. However, according to several studies on the digital gender gap, including a 2019 European Union report, women have lower levels of SL than men. The report reveals that only 17,2% of women in the European Union possess advanced digital skills, including statistical literacy, compared to 28,4% of men [20]. It implies that gender disparities can have an impact on statistical literacy. Women's lower levels of education can also contribute to their lower SL levels [21].

Some previous research on SL has shown gender differences in statistical knowledge and skills [20], [21]. The preceding points imply a clear need for research examining the associations between gender disparities and statistical literacy. Such research provides potential significant novelty and allows the identification of specific factors contributing to the gender gap in SL and how these gaps might affect women's lives. In addition, such research can also provide insight into how to address this gap and promote gender equality, particularly in SL.

However, with strategic planning and implementation of e-campus platforms, educational institutions have the opportunity to address gender disparities in SL and boost women’s engagement in STEM subjects. Since some previous research has focused narrowly on specific aspects of SL and may not fully capture gender differences in broader areas of statistical knowledge and skills, this research is focused on the association between gender disparities and SL that handles their limitation by involving an adequate sample size, determining the sample by random assignment with a matched subject, and capturing gender differences in broader areas of SL by exploring the association structure. Therefore, this study aims to reveal differences in SL achievement by gender, investigate the association structure between gender disparities and SL level, and explain the general tendency of SL level by gender.

2. RESEARCH METHODS

2.1 The Experimental Setting by Embedding E-Campus Platform

E-campus platform is a learning management system (LMS) that allows online learning. This platform is designed to facilitate blended learning or a hybrid combining traditional classroom-based and online learning, where educational institutions, lecturers, and students can interact with each other [22], [23]. The e-campus provides various features, including course creation, content management, e-presence, assignment submissions, assessments, and communication media such as discussion forums and messaging systems. These features allow lecturers to create interactive online courses. Students can access lecture materials, complete assignments, participate in online discussions, and communicate with lecturers and other students. E-campus also enables learning experiences that allow students to learn at their speed and level by providing adaptive learning technologies [24].

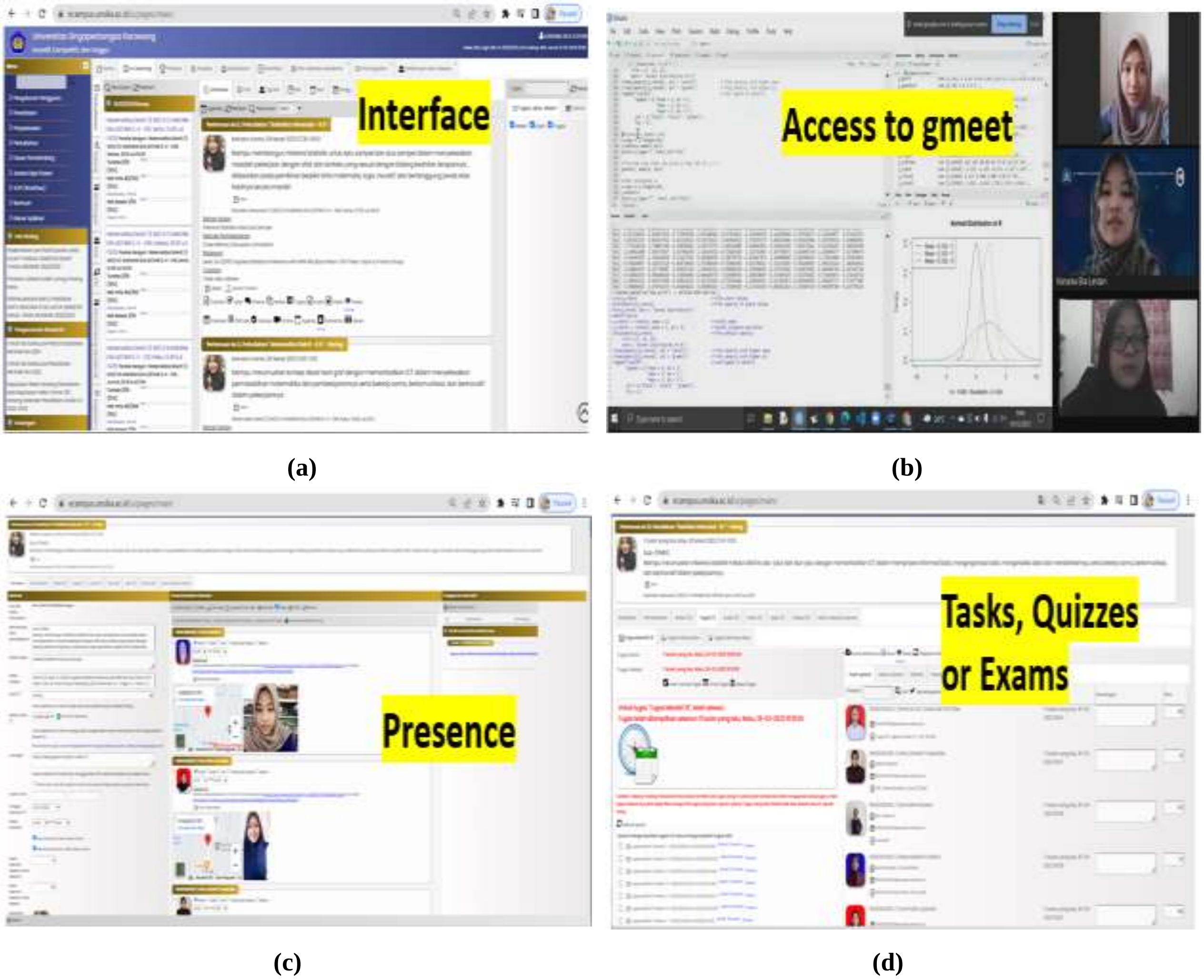


Figure 1. Embedding E-campus platform in the experimental setting provides various features, (a) interface, (b) access to google meet, (c) presence, (d) tasks, quizzes, or exams

The e-campus platform is the best choice for conducting online classes during the COVID-19 pandemic, as lecturers can interact with students virtually, discuss lecture materials, assign tasks, and even conduct secure online assessments and exams, making it possible to supervise students. The platform has a digital library containing a wide range of learning materials. Students can access the learning materials anytime, anywhere, which allows them more flexibility in completing their coursework. The e-campus platform has significantly reduced the time and costs of educational institutions and students. It reduces unnecessary trips and other back-and-forth activities, thereby increasing productivity.

2.2 Statistical Literacy and Gender

SL is the ability to interpret, critically evaluate, and communicate statistical information and messages [12], [14]. SL includes understanding and using the basic language and statistics tools [9]. Rumsey [25] mentioned explicitly that SL skills include interpreting graphs, reading tables and understanding the statistics presented in mass media. Watson [13] identified three stages as components of the "ultimate aim" of SL development of SL: (1) a basic understanding of statistical terminology, (2) an understanding of statistical language and concepts embedded in the context of a discussion, and (3) the development of a questioning attitude that can apply more sophisticated concepts to contradict claims made without a proper statistical basis.

Gender is related to a multidimensional nature, which constructs masculinity and femininity [3]. Gender refers to the socially constructed characteristics of women, men, girls, and boys. It includes the norms, behaviors, and roles associated with being a woman, man, girl, or boy, as well as relationships with each other [4]. Gender interacts with but is distinct from sex, which refers to the distinct biological and physiological characteristics of women, men, and intersex people, such as chromosomes, hormones, and reproductive organs [6]. In this study, we restrict the gender of men and women.

2.3 Research Design and Procedure

This study combines the quantitative and qualitative approaches sequentially. An explanatory design was performed to reveal the association structure between gender disparities and SL levels. In this design, we first conducted a quantitative study. Then, we used a qualitative one to follow up and refine the quantitative findings [26], [27]. As a higher priority, the quantitative study involves a placement test (PT), implementation of e-learning by using the e-campus platform, and an SL test. Qualitative research is a lower priority undertaken by a natural setting, observation, assessment, and evaluation.

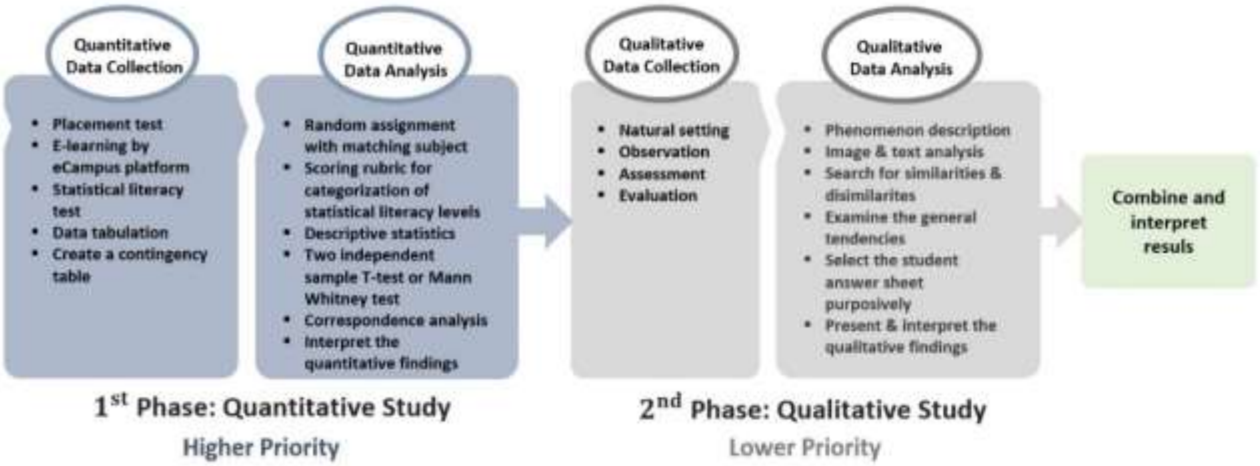


Figure 2. A mix-method approach by sequential explanatory design

The quantitative study in the first phase begins with a PT to establish baseline ability levels by gender. Since this study was conducted during the COVID-19 pandemic, learning activities were conducted in online classes organized by e-learning using the e-campus platform, undertaken after the PT. Random assignment was used to ensure that every student had an equal chance of achieving a certain score or level of SL, regardless of gender. SL test was given and analyzed quantitatively at the end of the first phase, where teaching and learning using the e-campus platform was implemented. Statistical testing for this quantitative approach is inferential statistics for two independent samples (T-test or Mann-Whitney test) and a chi-squared test for correspondence analysis.

The qualitative study in the second phase was used to expand upon the results of a quantitative study [27] a follow-up qualitative study held in the natural setting, and informal observation of online class activities. Assessment and evaluation of the student SL answer sheet were undertaken to describe the general tendencies of SL level based on gender. Assessment is a crucial component of higher education. However, the pandemic has posed many challenges to traditional assessment methods such as examinations, term papers, and projects. Online assessments, including quizzes, tests, and assignments, are submitted over the e-campus platform.

2.4 Participants

The sophomore from five classes enrolled in the course Inferential Statistics in Mathematics Education Study Program at Universitas Singaperbangsa Karawang served as a population of study participants. The classes involved 125 sophomores composed of 51 men and 74 women students who took the PT. The PL results identified 42 pairs (man-woman) of sophomores considered matched or equivalent. The sophomores who were not selected as study participants underwent the same teaching and learning process and accomplished the activities given to their respective classes. They were grouped with students identified as participants in the study. However, the data needed to address the research objectives were collected from the identified 84 of 125 sophomores as a sample of this study. All participants indicated their willingness to participate in this study.

2.5 Instrument and Data Collection

This research uses two main instruments: PT and SL tests. The PT is a standardized assessment tool designed to measure the student's prior knowledge, skills, and abilities in statistics. The test consists of 100 multiple-choice questions covering basic statistics and probability theory topics, equivalent to 100 points or one point per question. The PT was used to match sophomores with random assignments by assessing their initial level of knowledge or skill in statistics.

Random assignment was performed to ensure that the men and women groups had similar proportions of participants at each SL level. It helps to control for the potential confounding variable of initial SL ability, which could otherwise bias the study results. Using a PT to match subjects with random assignment can increase the study's internal validity and make more accurate conclusions about the effects of the intervention being studied.

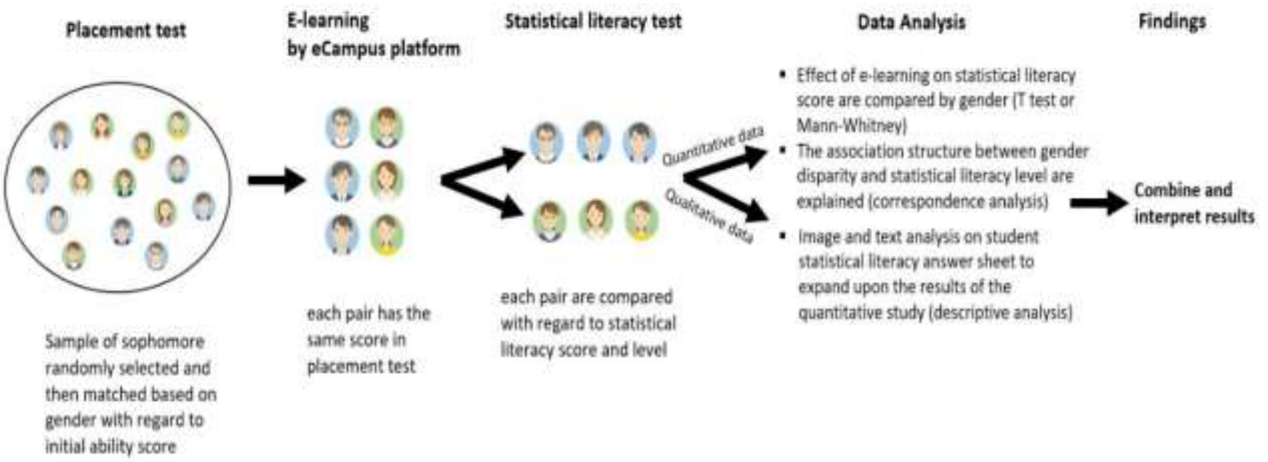


Figure 3. A random assignment with matched subject

The SL test instrument was carefully designed to consider the important guidelines in preparing test items. Test items were based on the topics in inferential statistics regarding the policies, standards, and procedures of the curricular program for Bachelor of Mathematics Education. The test comprised four items that measured students' ability to understand data, formulate and test the hypothesis, write a valid conclusion, interpret, and communicate statistical results, equivalent to 100 points or 25 points per item. The items examine the student's SL on statistical inference for one sample, two samples, simple linear regression, and nonparametric tests. The answer sheets were scored and classified into six levels modified by Watson & Callingham [28], as described in Table 1.

2.6 Instrument and Data Collection

All obtained data were analyzed using the sequential explanatory analysis [29]. Data from SL test results are converted into quantitative and qualitative data. The two forms of data are separate but connected— quantitative data measured in numerical value, both discrete and continuous data. The discrete data is obtained by categorizing SL into six levels: idiosyncratic, informal, inconsistent, and consistent noncritical, critical, and critical mathematical, which is an ordinal scale [28]. In addition, continuous data were obtained from SL scores. Meanwhile, the qualitative data consists of non-numerical information in the narrative form obtained from the student SL answer sheet.

Table 1. Description of statistical literacy level

Level	Description
1-Idiosyncratic	Know some statistics, but it is highly individualized and not based on formal training or education. Students in this category may have picked up statistical knowledge through personal experiences, such as reading cell values in a table or having basic mathematical skills related to a simple calculation.
2-Informal	Understand some basic statistical concepts but need more formal education in statistics. Students may have learned statistical concepts through work experience, online courses, or self-study, such as interpreting graphs, charts, tables, and other visual data displays.
3-Inconsistent	They know some statistics formally, but their understanding is sometimes accurate or reliable. Students know basic statistical concepts such as mean, median, mode, standard deviation, correlation, and regression. Students may need help to apply statistical concepts and methods consistently and may make errors in their analysis.
4-Consistent noncritical	Apply statistical concepts and methods consistently but may need to understand their limitations or potential biases fully. Students understand basic statistical concepts and can perform statistical analysis effectively but may not question the validity of the data or the assumptions underlying their analysis.
5-Critical	Strong understanding of the assumptions or limitations of statistical methods. Students can identify potential sources of bias and error, understand why data are needed and how they can be produced, critically evaluate claims based on statistical evidence, and identify common fallacies in statistical arguments.
6-Critical mathematical	Deep mathematical understanding of statistical concepts and methods. Students can apply advanced statistical techniques, develop new statistical models, and interpret and communicate their findings clearly and effectively to others orally or in writing.

2.7 Data Analysis

The quantitative data analysis aims to compare test scores by gender and seek the association structure between gender disparities and students' SL levels. The analysis was carried out through descriptive and inferential statistics. Descriptive statistics provides (1) basic information about SL scores by gender and (2) highlights potential relationships (association structure) between gender disparities and SL level by correspondence plot.

Inferential statistics were used to assess whether the average SL score for men significantly differed from that for women. The statistical tools used are the two independent sample T-tests or Mann-Whitney tests and correspondence analysis to reach the aims. Correspondence analysis (CA) is a data analysis and visualization technique used to investigate the associations between two categorical variables in a contingency table [30], [31]. CA is a powerful technique for better understanding the association structure between different variables. It was a popular method in statistics, ecology, marketing, sociology, material engineering, education, and other fields that deal with large amounts of categorical data [32]–[34]. CA aims to identify patterns and association structures between the categories of the two variables and to visualize these results in a graphical format [35]. The technique works by mapping the rows and columns of a two-way contingency table onto a low-dimensional space, which allows the associations between the categories to be visualized as points on a correspondence plot [36]. CA identifies the most significant associations between the categories and assigns those scores, which can be used to interpret the results

Suppose $\mathbf{N} = (n_{ij})$ is a matrix representing the $I \times J$ contingency table and $\mathbf{P} = n^{-1}\mathbf{N}$ is a correspondence matrix with $n = \sum_{i=1}^{I}\sum_{j=1}^{J} n_{ij}$. Let $= min\ \{I, J\}$ such that $\vec{r} = \mathbf{P}\vec{\mathbf{1}}$, $\vec{c} = \mathbf{P}^t\vec{\mathbf{1}}$, $\mathbf{D}_r =$ diag $(\vec{r})$, and $\mathbf{D}_c =$ diag $(\vec{c})$, respectively, are the vectors and diagonal matrices of marginal frequencies of $\mathbf{P}$ with $\vec{\mathbf{1}}$ being a vector whose each element is one. CA using singular value decomposition as follows

$$\mathbf{D}_r^{-1/2}(\mathbf{P} - \vec{r}\vec{c}^t)\mathbf{D}_c^{-1/2} = \mathbf{U}\mathbf{D}_\lambda\mathbf{V}^t, \quad (1)$$

where $\mathbf{D}_\lambda =$ diag $(\lambda_1, \cdots, \lambda_{K-1})$ is a diagonal matrix of singular values in descending order, $\mathbf{U}$ is an orthogonal matrix and the columns of $\mathbf{V}$ are orthonormal. The row categories of $\mathbf{N}$ are represented by the row and column principal coordinates, i.e.

$$\mathbf{A} = \mathbf{D}_r^{-1/2}\mathbf{U}\mathbf{D}_\lambda \text{ and } \mathbf{B} = \mathbf{D}_c^{-1/2}\mathbf{V}\mathbf{D}_\lambda. \quad (2)$$

An asymmetric row plot generated by **Equation (1)** isplays the associations between the row categories (SL level) of one variable against the column categories (gender) of the other variable. The plot is not symmetrical since the rows are weighted by their contribution to the total variance. At the same time, the columns are unweighted **[30]**, **[37]**. A point on the plot represents each category, and the distance between the points reflects the strength of the association between the two categories **[38]**.

The qualitative data was used to explain and interpret quantitative results by purposively describing the student answer sheet selected using image and text analysis **[39]**. The student answer sheets are analyzed by (1) searching for similarities among all or some of the students' answers, (2) determining differences in the content of the student's answers; (3) examining the similarities and differences to determine general tendencies; and (4) present and interpret various types of participants, statements, information considering the individual cases **[40]**.

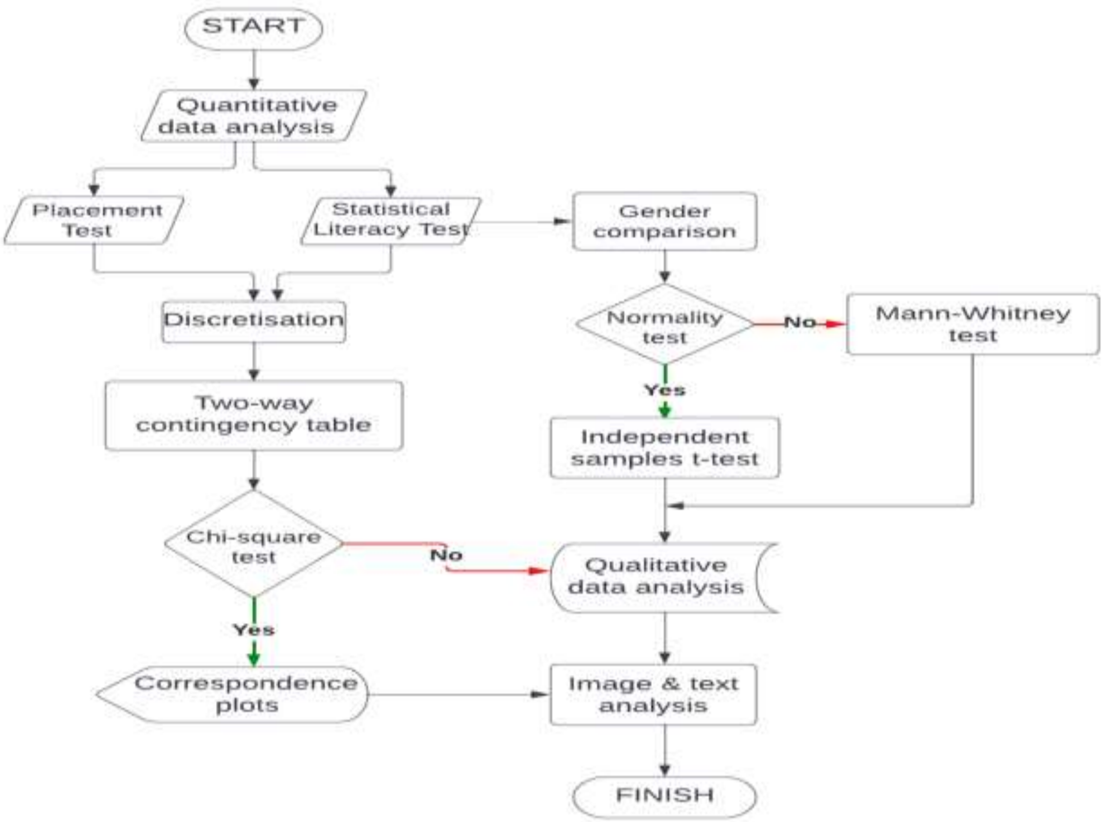


Figure 4. Flowchart of data analysis

3. RESULTS AND DISCUSSION

3.1 Quantitative Findings

A sample of 42 pairs of sophomores was randomly selected and matched based on gender concerning initial ability score. Each pair had the same PT score and was compared according to SL score and level. A descriptive statistic of the SL score by gender is summarized in **Table 2**. The table contains the central tendency measures and variability measures for SL score data.

Table 2. Descriptive statistics of statistical literacy score

Statistics	Men	Women
Minimum	18	40
Maximum	85	90
Range	67	50
Lower quartile	66.25	71
Median	71	77.5
Upper quartile	79.25	81.75
Mean	69.57	76.24
Standard deviation	14.46	9.00

According to **Table 2**, the minimum and maximum SL scores for men are 18 and 85, whereas for women are 40 and 90. Thus, their respective range is 67 and 50. The range represents the interval that contains all the SL scores. Since the range SL score for men is larger than for women, dispersion in the men's scores is larger than in women's. Table 2 exhibits that the lower quartile of men's and women's SL scores, respectively, are 66.25 and 71. It indicates that 25% of their respective SL score are less than or equal to these scores. Similarly, 75% of men and women SL scores are less than or equal to 79.29 and 81.75, respectively. Since their medians are 71 (men scores) and 77.5 (women scores), less than their respective mean, they are piled up toward the high score. Both the SL scores distributions resemble negatively skewed distributions. On average, the SL score for men is less than that for women, with the respective mean of 69.57 and 76.24. Conversely, the standard deviation of the men's score (14.46) is greater than the women's score (9.00). This indicates that the SL score of the men is more spread out than its mean.

Some researchers mention that the gender disparities phenomenon in mathematics and statistics refers to gender disparities, stereotyping, and discrimination against women. Women are often stereotyped as less capable in math and statistics, leading to lower expectations and fewer opportunities to excel in these areas **[3]**, **[4]**, **[6]**. However, the findings of this study show the opposite, where the average SL test score of women is more than that of men.

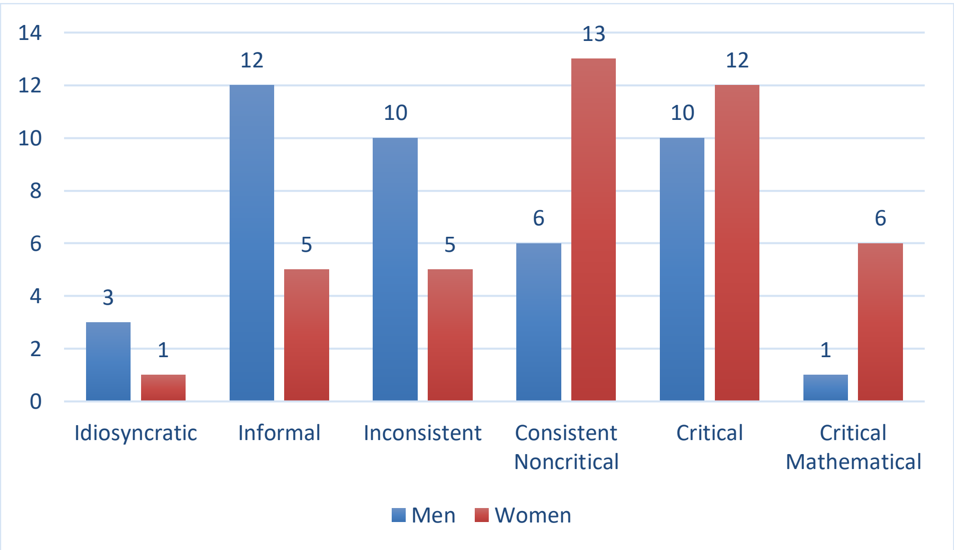


Figure 5. Three-dimensional contingency table for statistical literacy level by gender

A cross-tabulation of sophomores by gender and SL level is presented graphically in **Figure 5**. The figure reveals potential relationships (association structure) between gender disparities and SL. It shows that the low-middle level of SL (idiosyncratic, informal, and inconsistent) is dominated by men. Conversely, women tend to dominate high-level SL levels such as "consistent noncritical," "critical," and "critical mathematical." Furthermore, correspondence analysis revealed whether the association was statistically significant.

The quantitative findings emphasize inferential statistics on two aspects: (1) comparison of SL test scores regarding gender disparities, and (2) seeking the association structure between gender disparities and SL level. **Table 3** reveals that the assumption of normality should be rejected. This implies that the SL scores of men and women do not come from a normal distribution. If the normality assumption was violated, the Mann-Whitney test was used as a nonparametric alternative to a two-independent sample t-test. Since the p-value of the Mann-Whitney test is less than the level of significance $\alpha = 0.05$, the null hypothesis (H_0) should be rejected. It suggests a statistically significant difference between the SL scores of men and women.

Table 3. Comparative analysis of the statistical literacy score by gender

Test	Group/pair	Statistics	P-value	Decision	Conclusion
Shapiro-Wilk	Men	0.715	<0.0001	H_0 is rejected	Does not normally distributed
	Women	0.890	0.001		
Mann-Whitney	Man-Woman	581.5	0.007	H_0 is rejected	There is a difference in the median SL score

**significant at 0.05*

The Mann-Whitney test concludes that for a 95% confidence interval, there is a statistically significant difference between the SL score of men and women, as concluded in some previously conducted studies noting that women students had significantly higher scores than men students **[41]**. This result also differs from Yotongyos et al. **[42]**, which found non-significant differences in SL levels between men and women students.

Several studies in the literature indicate there exists a difference in various aspects of SL by gender. Wirthwein et al. **[43]** revealed differences in achievement goal orientation, with men favoring performance goals and women favoring mastery goals. Martin et al. **[10]** suggested that the men students were more focused on the outcome. In contrast, the women students were more process or task-engaged and concentrated on mastering the process. It indicates that there is an association between SL and gender.

The structure of association between SL level and gender was analyzed using CA. A visual representation of the association between SL level and gender is depicted on the asymmetric correspondence plot, as exhibited in **Figure 6**. This plot was generated through correspondence analysis by using **Equation (1)** and **Equation (2)** and used to identify patterns or structure associations between SL level and gender.

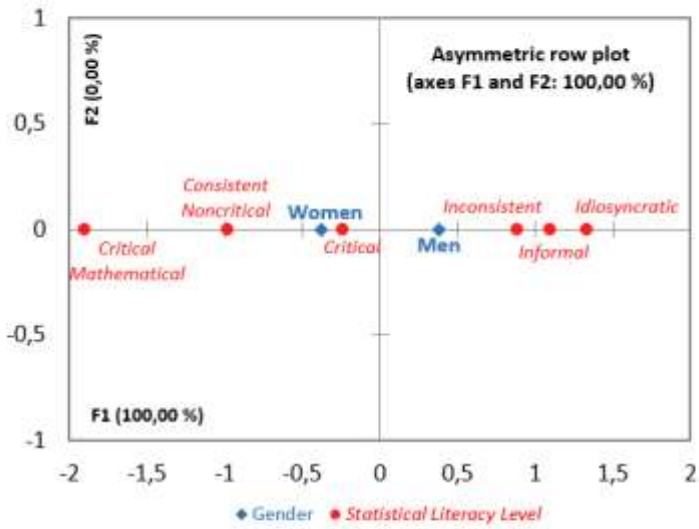


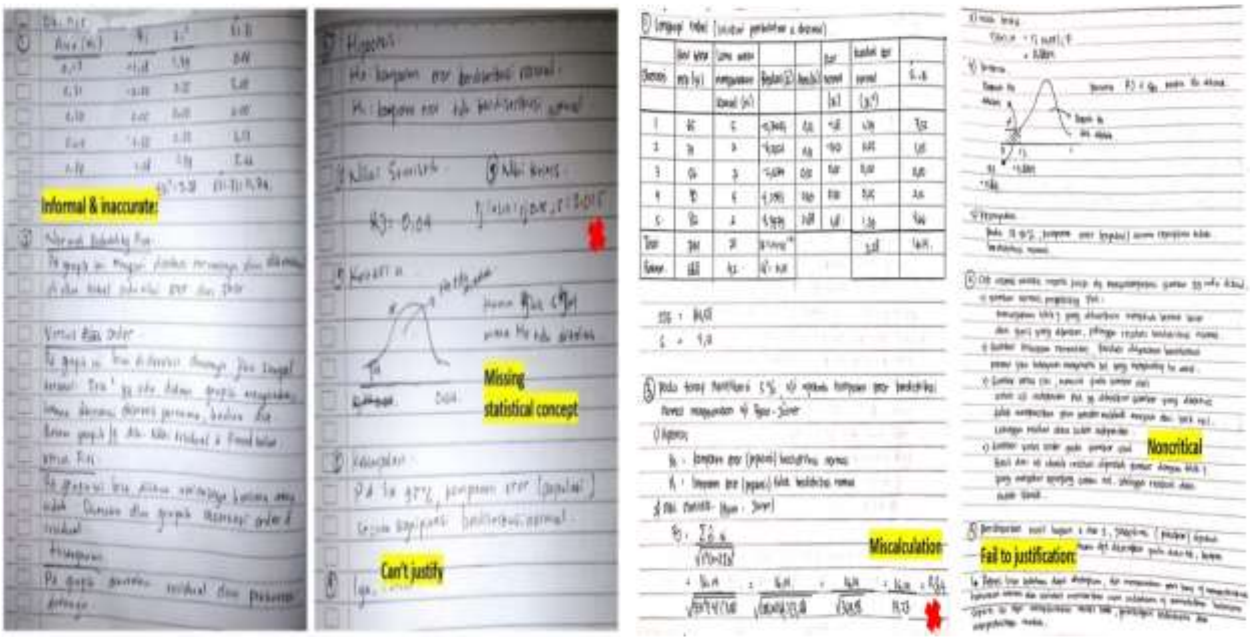
Figure 6. The asymmetric plot for statistical literacy level by gender

According to **Figure 6**, the men's coordinate point could be more consistent, informal, and idiosyncratic sequentially. It indicates a strong association between men and inconsistent, informal, and idiosyncratic levels. Similarly, the women coordinate tends to be close to critical, consistent noncritical, and critical mathematical coordinates. It implies that women strongly associate with critical, consistent noncritical, and critical mathematics. Therefore, men tend to strongly associate with the middle-low SL level, reverse with women with a strong association with the middle-high SL level.

The Pearson chi-square test is commonly used to evaluate the fit of a correspondence analysis result. Since the test yield Pearson chi-squared statistic of =11.881 with a p-value of 0.036 less than $\alpha=0.05$, it suggests that for a 95% confidence interval, there is a statistically significant association between SL level and gender. The findings are analogous to those of Tempelaar et al. [44] who reported the gender effect in statistics for the ability to reason correctly. Similarly, Martin et al. [10] discovered that gender influenced SL in multiple ways, one of which is that women significantly negatively impact statistical reasoning. Conversely, Garfield. Conversely, Garfield [9] noticed no correlation between gender and performance in statistical reasoning or SL. However, the previous research has a limited range of studies, and the association structure between gender disparities and the SL level remains unanswered. The study of the association structure that combines the results of correspondence analysis, image analysis, and text analysis was not found in previous studies.

3.2 Qualitative Findings

Qualitative findings from collecting and analyzing non-numerical data involve student answer sheets, observation, assessment, and evaluation. This analysis aims to explore SL level and gender disparities phenomena in depth, generating new insights and theories supporting the quantitative findings obtained previously. The image and text analysis of the student SL answer sheet was used to identify patterns and trends in how students solve the SL problem. The following figures present the student SL answer sheets selected purposively to consider the research goals. Figures 7 provide the student answer sheets representing the general tendencies of male and female students with low SL levels.

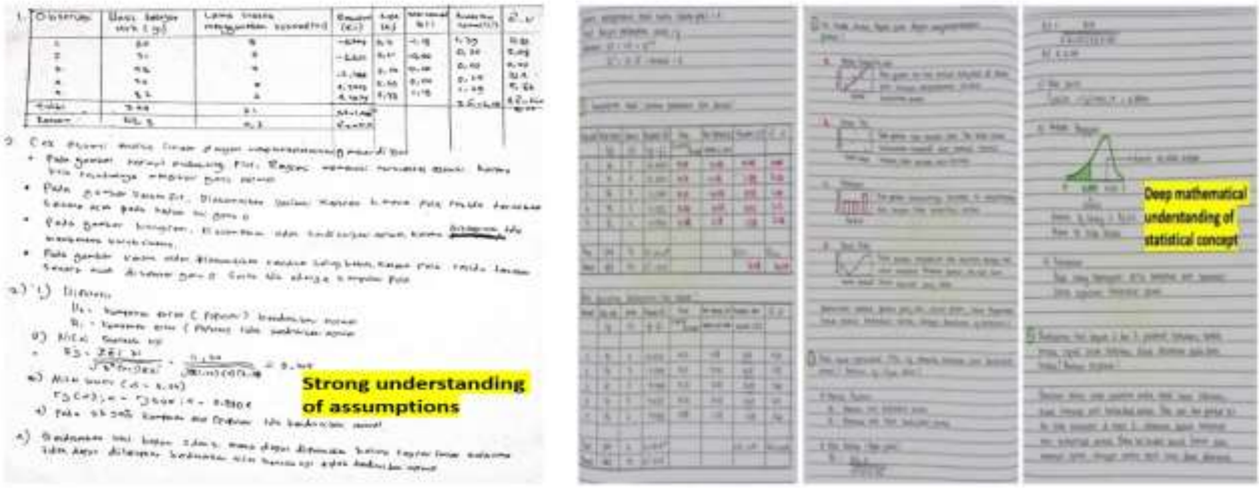


(a) (b)

Figure 7. The student answer sheet with a low statistical literacy level, (a) An example of a man student's answer, (b) An example of a woman student's answer

Based on the image and text analysis, it was found that male students with low SL levels tend to be able to perform simple calculations but need help understanding a statistical concept related to the inference. They know the data or some statistics and how to read cell values in a table but need formal education in statistics, and their understanding is only sometimes accurate or reliable. On the other hand, the women students with a low SL level tended to have basic mathematical skills but sometimes needed to be more precise. They understand some basic statistical concepts or methods formally. They can apply them but may need to be more critical in catching the limitations or potential biases in the concept or method.

Meanwhile, the student answer sheets represent the general tendencies of male and female students with high SL levels, as exhibited in **Figure 8**. This figure shows that male students with a high SL level tend to understand the assumptions and limitations of statistical methods and can critically evaluate data and statistical analysis. Nevertheless, they are reluctant to elaborate on what they arrest and often give short answers without further explanation. Meanwhile, female students with a high SL level tend to relish compiling a solution by detailing each step, starting from understanding the data, formulating and testing the hypothesis, writing a valid conclusion, and interpreting and communicating the statistical results. As such, they tend to have a deep mathematical understanding of statistical concepts and methods, including applying advanced statistical techniques, developing new statistical models, and interpreting and communicating their findings clearly and effectively to others orally or in writing.



(a) (b)

Figure 8. The student answer sheet with a high statistical literacy level, (a) An example of a man student's answer, (b) An example of a woman student's answer

This study's higher SL level of women than men students is noteworthy. These findings could break the stereotype that women are less statistically literate than men. It contributes to narrowing gender disparities and improves SL education. The qualitative findings offer insights into gender differences in statistical inference. The research shed light on how men and women approach inference differently. Such insights can help improve how SL is gained and communicated to both genders.

4. CONCLUSIONS

The COVID-19 pandemic has taught us the critical role of remote learning, and e-campus platforms have provided an excellent solution for educational institutions worldwide. Despite the challenges, e-campus platforms have catered to the needs of students, teachers, and institutions and paved the way for a new era of education that values accessibility and flexibility. In conclusion, the findings exhibited there is evidence to suggest that:

1. The SL of men and women is statistically significantly different, where the female students had significantly higher scores than the male students, with respective means of 76.24 and 69.57.
2. SL and gender have a statistically significant association, where men tend to have a strong association with the middle-low SL level and reverse with women with a strong association with the middle-high SL level.
3. SL of men and women has different tendencies in multiple ways. The men's goal orientation focuses on the outcomes. They tend to be reluctant to elaborate on their knowledge and often give a short answer without further explanation. Meanwhile, women's goal orientation focuses on processes and builds reasoning. Women tend to relish compiling a solution by detailing each step by step.

The findings provide the other insights for future researchers and practitioners in addressing the gender gap in SL and develop interventions to increase SL and promote gender equity in education. Future studies could explore the impact of statistical education on gender disparities to determine whether increasing SL can positively impact the reduction of gender disparities.

ACKNOWLEDGMENT

The authors thank LPPM Universitas Singaperbangsa Karawang for supporting this collaboration research.

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