INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY: APPLIED BUSINESS AND EDUCATION RESEARCH
2025, Vol. 6, No. 3, 1545 – 1562
http://dx.doi.org/10.11594/ijmaber.06.03.36

Research Article

Equipping Vocational College Students with Statistical Literacy: A Demonstrative Workshop on Statistical Tests and Procedures to Improve Rigor in Students' Final Year Project Data Analysis

Sirhajwan Idek*, Rowdella Raymond, Sufi Abidin Mislan, Yushahfira Akul, Dayang Siti Khatijah Awang Damit, Lumang Anak Lang

Malaysia

Article history:
Submission 03 February 2025
Revised 28 February 2025
Accepted 23 March 2025

**Corresponding author:*
E-mail:
sirhaj87@gmail.com

ABSTRACT
The purpose of this research project was to learn about the experience that final year students of Keningau Vocational College Statistical had in a physical workshop on statistical methods as well as their need to learn more about statistics and the software used to process them in helping them with their quantitative data analysis in their final year project development. Past final year projects only presented raw data which the students used to draw conclusions from without using any detailed statistical methods to identify trends and patterns. Therefore, their findings remained superficial, generic and less meaningful which made it harder for their findings to be deemed as valid, reliable and convincing. Hence, a statistical test and procedure workshop which featured live demonstration of a predetermined set of data was conducted on all final year students at the college. The software used was Statistical Product and Service Solutions (SPSS). The live demonstration was followed by the students' attempt in emulate the procedure shown to them in order to help them understand it better. They were required to purchase and install the software prior to the workshop. The findings revealed that the students felt that their understanding of the topic improved significant after the workshop and they deemed the software to be useful in their data analysis but found it challenging to use. The students' responses also implied that the students felt the hands-on and interactive instruction with guided practice could help them become more adept at using the software and gain better understanding of the topic. The findings signified the need to explore several instruction and learning methods as well as materials that may significantly improve the delivery approach. The findings also revealed a compelling need to fully integrate statistical tests and procedures into the vocational college curriculum.

Keywords: *Statistical literacy, Statistical methods, Final year projects, Quantitative data, Vocational college*

How to cite:
Idek, S., Raymond, R., Mislan, S. A., Akul, Y., Damit, D. S. K. A., & Lang, L. A. (2025). Equipping Vocational College Students with Statistical Literacy: A Demonstrative Workshop on Statistical Tests and Procedures to Improve Rigor in Students' Final Year Project Data Analysis. *International Journal of Multidisciplinary: Applied Business and Education Research*. *6*(3), 1545 – 1562. doi: 10.11594/ijmaber.06.03.36

Introduction

Every final year student in the diploma program of vocational colleges in Malaysia must complete a final year project, comprising project development as well as writing and presentation, as a requirement for them to fulfill. In fact, the final year project is a course that is split into two semesters in the final year in which the first semester of the course is dedicated to the development of their project proposal while the second semester requires them to realize the project and complete the written report of their project which includes data collection and data analysis. The national reference book on vocational college final year project provided by the Technical and Vocational Education and Training (TVET) of Ministry of Education is a merely a book which explains and illustrates the writing format of the report but it does not cover research methods although methodology and findings are two main chapters in the final year project report that the students must complete and submit. Majority of the students from each cohort often opt for quantitative data namely through surveys, rating forms and observation checklist. Hence, this project was intended to train the students on Statistical Product and Service Solutions (SPSS) which is a statistical software developed to analyze data in social science. The goal was to enable these students to access, understand and apply this software to perform statistical tests on their final year project quantitative data and subsequently for the researchers to gain insight on how the teaching of statistical tests can be integrated into the final year project course. In the long run, enabling the students to use statistical tests and procedures in their data analysis can improve the rigor and validity of their research findings which will lend their research justification and discovery a convincing and compelling contribution to the world of academia and the real-life industry.

Problem Statement

Although majority of the students chose to quantitative data which they collected through survey involving respondents from specific groups or panel evaluation which was done by a group of experts, they did not conduct in-depth analysis of their quantitative data and presented only the raw data in the form of numbers or percentages in tables or charts. This has caused their projects to remain superficial especially when such raw data only provided them generic summary of their findings with no rigorous means of drawing interpretations based on different types of statistical analysis that may showcase correlation, cause-effect influence, reliability and other forms of significance. As a consequence, they were unable to properly substantiate the discussion, implications and discoveries with statistical evidence.

Furthermore, understanding statistical tests and procedures can help students understand how they can connect and link different variables and this can profoundly influence their project ideation and the formation of their project objectives since they must first determine what interconnected relationships and patterns between variables in their project that they want to explore. Prior to this, the students' project purpose and objectives barely explored any relationship and this resulted in them being unable to justify their projects properly, determine clear goals or expected implications of the projects and ultimately, they hardly uncover any new discovery that was significant to the discipline that they were doing their study on or to the world in general.

Objectives

1. To improve vocational college students' understanding of statistical tests and procedures through an explicit demonstration of a given set of data by using a statistics software.
2. To elicit students' feedback on their experience in the statistics workshop in several aspects mainly the installation process of the software, the materials and instructions given by the trainer and their level of understanding of the statistical tests and procedures that they were introduced to.

Statistical Literacy

Being a well-informed and responsible member of a society either as professional or non-professional users, one needs to be able to understand socioeconomic phenomena and the

relationship between them and such understanding is built on statistical literacy, data literacy, statistical thinking and use of visualization methods (Kovacs, Kuruczleki, Kazar, Liptak, Racz, 2021). It is sufficient to posit that everyone needs to attain basic statistical literacy in order to be able to understand basic data that are relevant to our life and it can be as important as information literacy and digital literacy. Yuniawatika (2018) summarized statistical literacy is the ability to understand, interpret, evaluate, and communicate statistical data through various media critically. This indicates that statistical literacy is a basic skill in interacting with data that are presented in various means throughout our personal and professional life.

Takaria (2010) argued that statistical literacy is important for students to understand information delivered via statistics and make informed decision based on this information, to process and analyze research data and present them properly in academic writing and respond to problems that entail statistical information. It is highly recommended for students to master the basics of statistics since this branch of knowledge can be useful in their study as well as their everyday routine.

Statistical Tests and Procedures in Students' Academic Works

Kumar (2024) stated that statistical analysis is the process of collecting and analyzing data in order to discern patterns and trends which is very useful in interpreting research findings as well as in study and survey planning. The test and procedures enable researchers to process raw and unstructured data and convert them into patterns and trends where meaningful conclusions can be drawn from. According to Martin (2024), statistical methods is also crucial in helping researchers to make important decisions based on the most plausible option as seen from data interpretation. It is also imperative to ensure that accurate and reliable results are attained from the research process by taking variability and uncertainty into account. Thorough statistical analysis also gives research a degree of credibility and authenticity that makes it convincing and more compelling. It is evident that using statistical analysis is imperative for researchers to identify trends, patterns and connections between the data that they gather which allows them to deduce substantiated conclusions which lead to informed decisions and subsequently, a justified course of action. If vocational college students report their project findings without the use of statistics, they are only providing raw and unstructured data which can be hardly used as a basis to draw informed and substantiated meaningful conclusions that are vital in determining the need for subsequent actions to be taken accordingly.

Ben-Zvi and Gravemeijer (2018) proposed six interrelated key elements to create an effective and positive statistical learning environment in and outside the school which can develop students' statistical reasoning and to encourage them to use statistics; the emphasis must be on developing central statistical ideas rather than on tools and procedures, well-designed tasks to support the development of statistical reasoning, real or realistic and motivating datasets, use of technological tools for students to explore, classroom culture that fosters statistical arguments and assessment on students' statistical learning and teachers' instructions. Hence, familiarizing students with statistics in their learning is instrumental in bolstering their ability to understand, use and evaluate statistical information and procedures.

Davidson, Jabbari, Patton, O' Hagan and Peters (2019) postulated that statistical software in a statistics course has shown to improve college students' understanding of statistics, using English in statistics and able to use statistical methods in their final theses according to requirements. Mazouchova, Jedillickova and Hlavacova (2021) explained that since statistical software does the calculation for the students, they can focus on putting the input for the statistics and interpret the results. This does not only save the time but also reduces the stress on those whose mathematics is not their strong suit. They recommended the use of statistical software and the use of teaching methods where students learn through practical and specific samples of data that can enable them to master each statistical operation instead of theoretical lectures that does not cater to students'

need for active learning. It is evident that statistical software such as SPSS

Methodology

The workshop was conducted on 17th January 2025 at the hall of Keningau Vocational College. Over 100 students from seven vocational programmes and these programmes were Automotive Technology, Construction Technology, Welding Technology, Electrical Technology, Cosmetology, Bakery and Pastry and Culinary Arts. The trainer was a mathematics teacher who was also teaching a statistics course to at least one of the vocational programme. Prior to the workshop, a purchase link of the software has been given to these students so they could download and install this software beforehand. A few teachers assumed the role as facilitators during the workshop. The students were introduced to the use of the software through a projected display on a huge screen at the venue where the trainer did his live demonstration for each software by using a predetermined set of data. The students were expected to pay attention and emulate the procedures shown by the trainer step by step. The workshop took place within two hours.

Once the workshop ended, the online survey was made accessible to them where they were required to complete it individually. The survey consisted of six parts: demographics, purchase and installation of the software, content and delivery, tools and resources, learning outcomes and finally, open-ended questions on challenges and suggestions. The questionnaire was developed from the different aspects of this intervention that were crucial in gaining better understanding of the students' experience. The questionnaire clearly stipulated the purpose of the research and the commitment of the researchers in keeping the identity of the respondents anonymous and confidential. The online form also included a consent checklist in which the submission of their answers was deemed as them providing consent to their data being used for the research. 70 students completed the questionnaire.

Thematic analysis was used to analyze the open-ended responses. According to Braun and Clarke (2006), thematic analysis involves inducing qualitative data into clusters of similar conceptual categories which leads to the identification of consistent patterns between themes. Paired sample t-test was used to determine whether there was a significant difference in students' understanding of the topic before and after the workshop while chi-square tests were used to determine the difference of the students' understanding of the topic in respect to the vocational programmes that they were from prior to the workshop and after the workshop was conducted.

Findings and Discussion

The responses from the survey were extracted in order to obtain an overview on the students' experience and feedback on the workshop. The responses form the quantitative items are presented in statistics.

Findings of the Quantitative Data

The 70 students who completed the survey came from the seven vocational programmes that were taking final year project course in their fourth year of diploma study at the institution.

Table 1.0. Paired Sample T-Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Bengkel ini meningkatkan pemahaman saya terhadap analisis statistik - PENGETAHUAN ASAS TERHADAP STATISTIK SEBELUM MENGHADIRI BENGKEL	1.043	.600	.072	.900	1.186	14.533	69	<.001

There was a significant difference between the students' understanding before the statistical software workshop and after the workshop was conducted as the p-value is less than 0.001 which is lower than the standard threshold of 0.05. This indicated that the difference is statistically significant. The workshop has significantly improved participants' understanding of statistical analysis. The fact that p-value is very low means that the improvement was not due to chance.

Table 2.0. Chi-Square Test on Students' Post-Workshop Understanding of the Topic According to Programmes

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.922[a]	6	.178
Likelihood Ratio	9.060	6	.170
N of Valid Cases	70		

a. 7 cells (50.0%) have expected count less than 5. The minimum expected count is 2.23.

There was no significant relationship between the students' understanding after the workshop was conducted with the vocational programmes that they came from. Since p-value is greater than 0.05 (0.178) which means the result is not statistically significant. This may indicate that the students have generally attained nearly the same level of understanding of the topic after participating in the workshop.

Table 3.0. Chi-Square Test on Students' Understanding of the Topic According to Programmes Prior to the Workshop

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.564[a]	6	.035
Likelihood Ratio	15.445	6	.017
N of Valid Cases	70		

a. 8 cells (57.1%) have expected count less than 5. The minimum expected count is 1.97.

Since P-value is less than 0.05 (0.035), it means that students' level of understanding of the topic according to their vocational programmes was statistically significant. This signified that students from different programmes had different levels of understanding of the topic. This could be attributed to the fact that some programmes namely Construction Technology and Electrical Technology were introduced to several statistical methods in one of the courses that they studied in the previous semester.

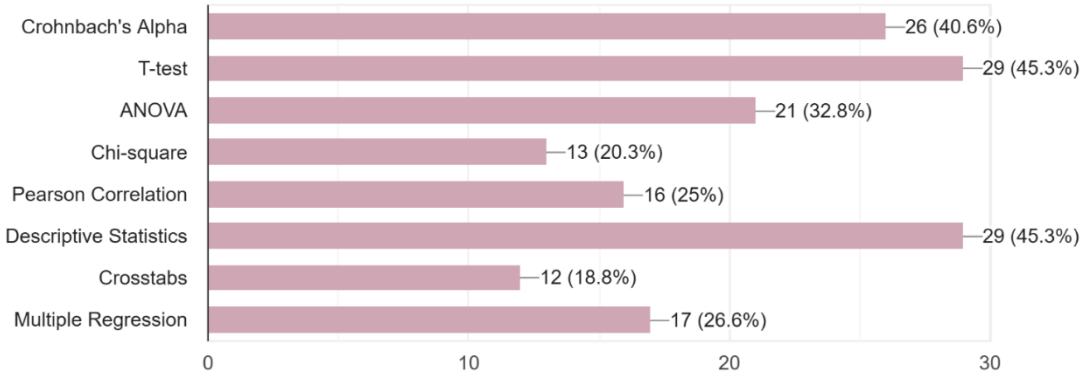


Figure 1. Students' Rating on Statistical Operations Based on Their Significance to Their Learning

Most of the students rated t-test and descriptive statistics as the two most beneficial statistical operations. This was followed by Cronbach's Alpha and the fourth most significant was ANOVA. It was apparent that these were the statistical tests that were probably the most relevant to the vocational college students' final year project rationale and purpose.

Findings of the Qualitative Data

The questionnaire contained three open-ended questions which were not mandatory for the students to answer. This part was divided into three different questions inquiring the students' opinions on the valuable aspect of the workshop, their challenges in using the software including the processes involved in running it as well as their suggestions on how to improve this workshop.

Table 4.0. The Valuable Aspect of the Workshop

The aspect of the SPSS workshop which was most valuable for you		
Survey responses	Code	Theme
Dapat tahu cara menganalisis data (P6)	Learning how to analyze data	Acquisition of newfound understanding on the use of SPSS
Saya dapat mempelajari bagimana mau menganalisis data menggunakan SPSS. (P34)		
Memberi pengetahuan yang baru kepada saya. (P25)	Gaining new knowledge	
Saya dapat mempelajari benda baharu (P35)		
Dapat belajar benda baru seperti SPSS (P29)	Learning new topic	
saya dapat memahami dengan lebih baik tentang penggunaan dan kegunaan SPSS (P38)	Gaining better understanding of the use and the application of the software	
Dapat info kegunaan dan kebaikan menggunakan spss, berlaku kebingungan selepas terlalu banyak cara analisis data yg berlainan dijelaskan sehingga tidak tahu apa yg sesuai dengan jenis data projek. (P68)	Gaining new understanding on the benefits and the purpose of the software despite the difficulty in distinguishing the different statistical methods being presented	

The aspect of the SPSS workshop which was most valuable for you		
Survey responses	Code	Theme
kegunaan spss (P32)	Understanding the software's functions	Understanding the features and functions of the software
Analisis Maklumat (P65)		
Memudahkan membuat analisis maklumat (P55)	Ease of Use	
membuat data dengan mudah (P61)		
Mudah untuk digunakan (P63)		
Keperluan untuk Kajian (P46)	The need of such software for research	
Tentang slot kuantitatif dan kualitatif (P47)	Distinguishing qualitative and quantitative data	
Cronbach alpha (P53)	Becoming familiar with different types of statistical method	
Cronbach alpha (P54)		
T-test (P13)		
semasa cikgu mengajar saya untuk memasukan data tersebut (P7)	Replicating the teacher's demonstration accordingly	Trainer's direct and demonstrative instruction
Dapat tunjuk ajar dari guru pakar (P27)	Guidance from an expert teacher	
tutorial memakai SPSS (P41)	Tutorial on how to use the software	

The responses implied that the students attributed their newfound understanding of the software and how it is used in analyzing data through several statistical procedures to the workshop. They also commended the trainer's instruction. Based on the quantitative data, 67.1 % of them said that they had no basic knowledge prior to the workshop and 96% stated that they required a more focused workshop as a follow up to the one they attended. It can be deduced that the statistical methods as well as the software were new to these students which explained why they personally felt that they were learning new topic and requested for subsequent classes or workshops on this topic.

Table 5.0. Challenges in Using SPSS During the Workshop

Challenges during the process of purchasing, installing and using SPSS		
Survey Response	Code	Theme
Line tidak kuat semasa download :) (P6)	Limited Wi-Fi connectivity when downloading the software	Limited Wi-Fi Connectivity
Kesukaran tarikan internet ketika membeli, memasang dan menggunakan SPSS. (P28)	Limited Wi-Fi connectivity during the process of obtaining the software and using it	
Memerlukan rangkaian internet yang kuat dan memakan masa yang lama sekiranya terdapat gangguan pada jaringan internet (P38).	Limited Wi-Fi connectivity slowed the process of accessing the software	

Challenges during the process of purchasing, installing and using SPSS		
Survey Response	Code	Theme
Tidak tahu fungsi pada awalnya. (P3)	Lack of knowledge of its functions prior to the workshop or at the beginning of it	Lack of prior knowledge on the software
Kurang faham untuk membuat analisis menggunakan SPSS (P11)	Lack of understanding on how to use the software for data analysis	
Kurang pengetahuan SPSS (P30)		
Memasukkan data dalam SPSS. (P34)		
Kurang memahami cara penggunaan SPSS tersebut sendiri (P46)		
pemasangan dan penggunaan sangat mencabar sebab saya tak fahan apa-apa pun sehingga penyelaras kelas yang ajar. (P60)	Zero understanding on the software which made the installation and the process of using the software challenging	
cabarannya ialah semasa penggunaan iaitu lambat tangkap apa yang diajar oleh cg kerana pertama kali menggunakannya (P61)	First time user and this made it difficult to follow what was being taught	
Leptop bermasalah susah untuk dimuat turun. (P8)	Faulty devices during the downloading of the software	Slow or Delayed Performance of Devices
Masalah laptop (P21)		
Masalah laptop (P23)		
Dvice bermasalah (P65)		
HANDPHONE NGELAG (P31)	Device's delayed performance/screen lag	
Kurang budget (P13)	Insufficient money for the purchase of the software	Financial constraints for the purchase of the software
aplikasi harus dibeli dan tiada duit (P32)		
Kos (P41)		
Harga, susah ketika pertama kali mengguna (P55)		
Kewangan (P14)	Difficulty in purchasing the software due to financial constraint	
sebahagian murid masih tidak mempunyai bayaran dalam talian (bank online). (P20)	Absence of online account for transaction	
susah untuk memasang spss (P10)	Difficulty in installing the software	Difficulty in the steps involved to run the software smoothly
Susah untuk pemasangan spss (P22)		

Challenges during the process of purchasing, installing and using SPSS		
Survey Response	Code	Theme
SPSS sukar untuk dimuat turun pada laptop dan ada sedikit masalah iaitu SPSS tidak berjalan dengan baik semasa digunakan. (P25)	Difficulty in downloading the software and making it run and operate smoothly	
File to large (P26)	The size of the software was a factor	
Saya menghadapi sedikit masalah semasa membeli dan memasang spss tersebut. (P49)	Difficulty in purchasing and installing the software	
Kesukaran untuk membeli SPSS. (P59)	Difficulty in purchasing the software	
Tersilap membeli spss kerana terbeli untuk ip (P63)	Mistake made during the purchase of the software	
Speaker kurg jelas (P29)	Unclear audio stemming from the speaker	The lack of audio clarity due to the poor sound system
Speaker kurang jelas menyebabkan kurang tumpuan (P35)	The lack of audio clarity from the speaker dampened concentration	

The challenges faced by the students during the workshop were varied and mostly stemmed from technical issues such as Wi-Fi connectivity, sound system, devices as well as financial constraints since they were required to purchase the software on their own. Since most of them were never introduced to the software or the statistical tests before, they had difficulty trying to follow the instruction and demonstration given by the trainer on how to use the software in data analysis. The quantitative data revealed that 59% students faced challenges in purchasing the software, 40% said that it was hard to download and 50% felt that the use-friendliness of the software was satisfactory. Overall, their experience in using the statistical software needed more improvement and called for more support and assistance as well as better planning since some of the issues should be addressed prior to a workshop or a class. This is essential for them since their experience may heavily affect their motivation and concentration in learning about the topic and the software.

Table 6.0. Suggestions for Improvement

Suggestions on the improvement of the workshop		
Survey response	Code	Theme
Membuat bengkel ini program ke program supaya lebih jelas untuk di faham (P7)	A more structured and rigorous approach through one workshop at a time for each programme on a smaller number of students	A systematic and intensive series of workshop for each programme
taklimat diberikan secara teratur kepada semua program supaya mereka berfokus untuk setiap topik bengkel spss yang d terangkan dan diberikan kefahaman. (P20)		

Suggestions on the improvement of the workshop		
Survey response	Code	Theme
Melakukan bengkel SPSS ini mengikut kelas dan tunjuk ajar yang lebih mendalam. (P25)		
Bengkel secara kecil kecilan yg melibat satu program sahaja kerana terlalu banyak murid menyebabkan kurang fokus. Beri penjelasan dan tutorial yg jelas berkaitan dengan cara analisis data yg berfokus kepada data yg diambil. (P68)		
Lagi bagus buat kelas di setiap bengkel berbanding buat kelas beramai-ramai (P69)		
menyediakan satu bengkel untuk download SPSS secara beramai-ramai dan menyediakan rangkaian internet yag kuat kepada semua pelajar (P38)	A workshop for all students solely dedicated on downloading the software with strong Wi-Fi connectivity	
menggunakan contoh maklumat dari pelajar. (P3)	Student-centred demonstration	Experiential learning supported by adequate material and guidance
Melakukan aktiviti ataupun memberi nota ringkas cara penggunaan SPSS sebelum memberi penerangan. (P34)	Guided hands-on activities	
Buat aktiviti untuk mengelakkan pelajar bosan (P35)	Engaging activities	
E-pembelajaran dan aplikasi interaktif dalam pengajaran SPSS (P46)	Interactive E-Learning	
Lebihkan tutorial (P47)	Step-by-step guidance	
Menyuruh pelajar untuk buat agar lebih paham (P55)	Active participation of students via doing	
memberi penjelasan dengan lebih jelas agar pelajar dapat memahami dengan lebih jelas cara penggunaan SPSS (P5)	Explicit explanation	Explicit, well-paced and interactive approach
Jelaskn lebih tentang point yg ingin diberi (P29)		
beri penerangan dengan lebih jelas (P32)		
Penceramah harus lebih interaktif (P48)	Speaker's interaction with the students	
Menerangkannya secara perlahan lahan (P54)	Well-paced explanation	

Suggestions on the improvement of the workshop		
Survey response	Code	Theme
boleh bersama-sama men-download spss dalam dewan kerana ada murid yang tidak dapat mendownload spss (P10)	Assistance in purchasing the software	Provision of assistance for the purchasing and downloading phase of the software
MEMPERBAIKI PEMBELIAN AGAR LEBIH SENANG (P31)		
Mengunakan pa sistem yang lebih baik agar audio lebih jelas (P27)	The PA system needs to be audibly clearer within the venue	PA System needs audio improvement
Cari ruang yang boleh didengari semua orang dalam bengkel.... Saya tak dengar apa-apa masa tu dan blur sepanjang bengkel kecuai penerangan kualitatif. (P60)		
kalau bole ada guru untuk setiap kawasan meja sebagai pembimbing (61)	A ratio of one teacher for a specific number of students as facilitstors	Provision of adequate number of facilitators for the students

Majority of the students requested for workshops to be held specifically for each programme with a smaller number of students and greater rigor, hence, making it more effective. Some wanted the workshop to provide hands-on and interactive activities in order to improve their engagement. Many expressed the need to allocate time for students to obtain and install the software properly prior to instruction. Some believed that technical factors particularly the sound system must be improved. The data from the quantitative items showed that 86% of the students rated their understanding of the topic from the workshop as satisfactory and 47% stated that the teaching method or delivery during the workshop was also satisfactory. Only 41% of them claimed that they felt confident in using the statistical software after the workshop. It is apparent that the students were not able to fully understand the topic to the extent that they felt confident or competent in using the software as well as interpreting the purposes and the results of the different statistical methods.

Implication

This research has shed light on our multi-faceted education especially on how we can better internalize statistical literacy into our school context and classroom learning.

Statistical literacy influences students' project ideation and purpose

Statistical test and procedures are used to examine patterns and links between different factors and aspects that are relevant to the scope of a project. Hence, incorporating this topic into students' final year projects will heavily influence how they explore, conceive and formulate their project since they will consider relationship between any variables possible involved in and/or affected by their project which they may not be able to foresee without basic understanding of statistical operations. This will profoundly impact the students' quality of project especially the depth of their findings, the validity of their project implementation and reporting as well as the credibility and actionable takeaway from their project results. This also indicated that students may need to be introduced to such statistical procedures prior to their final year project course or at the very early stage of the course so they have ample time to master each test individually.

Familiarizing students with statistical literacy through formal and informal means

In order to be well-versed in statistical literacy and understand how important statistics are, it is essential to familiarize students with statistics and this is not necessarily done through a statistics course or a statistics topic in a course within a formal learning context. Statistical literacy must be incorporated into the formal and informal context at least at an institutional level through its use in other courses as well as in building signage, social media infographics, school programmes and activities which creates an environment where students interact continuously with statistics. This can improve their aptitude and attitude towards learning complex statistical tests and software, improve their basic understanding of statistics that can prepare them better for statistical operations that demand more rigorous interpretation. In the context of vocational college education, students must also be exposed to statistics in academic subjects such as English language and history as well as in their practical and theoretical classes on the vocational courses that they take. Statistics should be also included in school programmes such as career events, language weeks and community work.

Recommendation

Based on the analysis of the quantitative and qualitative data, several strategies in which some are consistent with learning theories and methods were drawn from the processed data in order to improve the instruction and intervention related to statistical tests and the SPSS software.

Reinforcing prior knowledge on statistical tests and procedures

Majority of the students did not have prior knowledge on the software as well as the statistical tests and procedures and this heavily influenced their ability to grasp what was being introduced to them during the workshop. In fact, most of them felt that they needed a follow-up workshop specifically for their class or programme instead of a whole-cohort workshop approach. It is more helpful if the students are introduced to the basics of statistical methods and the software including common terms and jargon related to statistics. Nevertheless, the students' self-evaluation on their understanding of the topics showed significant improvement after the workshop was conducted and they attained roughly the same level of understanding after their participation in the workshop regardless from which vocational programme that they came from.

Allocating time, money and resources for software installation

It was evident from the students' responses that many had problems downloading and installing the software due to various factors such as their lack of clarity on how exactly it should be done, the delay in their devices, the financial constraint since they had to purchase the software on their own and they also encountered several minor issues such as mistake made during the purchase and difficulty in running the software accordingly.

Explicit instruction

The students suggested for the instruction to be delivered in a more explicit and well-paced manner. This is consistent with the tenets of explicit instruction which Rosenshine (1987) described as "a systematic method of teaching with emphasis on proceeding in small steps, checking for understanding, and achieving active and successful participation by all students." This indicates that the instruction must be done in a sequence of stages where each stage delivers small amount of information or skills for the students to digest and practice and monitoring process will entail checking students' understanding and ensuring their active involvement.

Explicit instruction also emphasizes modelling new knowledge while explaining it directly so students are able to fully comprehend what must be done and they should be also given more opportunities to respond especially when they are expected to do independent practice after a guided practice (Flethcer, Lynn, Fuchs & Barnes 2019). This aligns with the responses obtained from the students which recommended interactive and hands-on activities where they compute the data themselves with

the guidance of the teachers in order to enhance their grasp of the topics.

One of the most important elements of explicit instruction is to begin the lesson with a clear statement of its goals and the teacher's expectation. It is extremely vital for the teacher to inform clearly to the learners what they will learn and why they are learning it since this will allow students to achieve better if they understand what and why they are learning a particular topic or skill (Archer & Hughes, 2011). As what can be deduced from the students' responses, the students felt that they could understand the statistical tests better if they were better informed on the basics of the software and statistics before the lesson delved deeper into the lesson content.

I Do, We Do, You Do model

According to Henshaw (2023), I do we do you do' is a method of modelling that starts with some demonstration by the teacher, then moves to supported practice involving the teachers who guide the students in doing a task or performing a skill and finally turning it into independent work where the students perform the task or the skill on their own. It is also known as the 'gradual release of responsibility' model because it begins with a teacher dominating the instruction and the demonstration before it finally becomes an activity where the students are tackling the problem independently. This model might suit our statistics teaching better since the students' responses revealed that they believed they would understand the topic better if they were given the chance to compute the data on their own after the teacher's demonstration in which they could instantly ask for guidance or assistance from the teachers when needed.

Morris (2023.) explains the model as a teaching strategy that involves a gradual release of responsibility from the teacher to the students and it consists of three phases as follows:

- I do: The teacher shows the students how to complete a task or solve a problem by employing several techniques such as think-aloud and demonstrations.
- We do: The teacher and the students work together to complete the same task or solve the same problem. The teacher provides support and guidance, when necessary, with active participation of the students.
- You do: The students work independently to complete a similar task or solve a similar problem. The teacher provides feedback and support when necessary but the students are responsible for completing the task on their own.

Some of the noteworthy aspects of this strategy is the use of visual aids such as diagrams as well as the use of worked examples to help the students better (Henshaw, 2023). This was consistent with what the responses from the students implied as they felt they could relate to the topic better if their data were used as examples by the teacher in demonstrating the use of the software. It is also recommended by Morris (2023) for teachers to use think aloud method in their instruction. It means they explain their reasoning as they break down larger steps into smaller more manageable steps throughout their demonstration. This was coherent with what the trainer attempted to do during the workshop. Based on the two references, this method suits mathematics and writing well due to the nature of the skills in these two respective areas that demand demonstration as well as guided and independent practices.

Microlearning

The responses from the students showed that the instruction should be split into smaller steps and students should be given the opportunity to practice each subtopic or subskill before the next one is introduced. It is likely that the students felt that this method could probably help consolidate and reinforce their understanding. This method is congruent with microlearning which is an emerging learning trend in the current time where attention span is becoming shorter and people are relying on mobile devices to access information.

Carter and Youssef-Morgan (2022) define microlearning as a learning approach ideally suited for skills training and is often narrowed to the most essential parts of a skill or a topic. It is therefore split into bite-sized exercises which makes microlearning shorter, quicker

but more concise. Several other characteristics are as follows:

- It's short in duration often in three to 10 minutes.
- It focuses on a specific concept, skill, idea, or topic.
- It can come in a variety of content such as text, presentations, infographics, video, audio, and even interactive games.
- It's usually designed for mobile devices to be easily accessible.

Microlearning can be delivered in short-form content that can be in many different platforms and each microlearning segment covers one or two objectives. Since it should be available in many multimedia content types, it is technology-based or enhanced. It acts as a performance support where users can easily retrieve it when it is needed particular for a highly complex task or task that is rarely performed (Taylor & Hung, 2022).

Based on these principles of microlearning, statistical tests and procedures can be taught by splitting it into different microlearning segments that are imparted to the students within a shorter amount of time before they are given the chance to practice the skill with guidance and/or independently. The content can also be prerecorded and be available to the students through digital platforms where they can access it whenever they need it.

Integration of statistical procedure in final year project syllabus for vocational colleges

In order to improve the quality of the students' final year project as well as the credibility of their projects to be continued, expanded and scaled up, it is necessary for vocational college students to learn statistical methods as part of their final year project course. This topic needs to be introduced through statistical software such as SPSS. Although there is a statistic course for several programmes such as Electrical Technology and Construction Technology at vocational colleges, it does not explore the variety of statistical tests in-depth since the focus is on descriptive statistics statistical sampling. It does not cover other statistical operations such as T-Test, ANOVA and Multiple Regression that serve certain purposes which the students may need to consider in developing their project goals and expectations.

Professional development programme on statistics for teachers

It is crucial for teachers to acquire the fundamental knowledge on statistics and statistical software. In addition, teachers who teach and supervise students' final year projects must be well-versed in this topic in order for them to be able to effectively impact and demonstrate the plethora of statistical tests to the students and guide them in doing the operations. Hence, continuing professional development programmes on this topic for teachers must be conducted on a regular basis.

Conclusion

This research signified the need for teacher's demonstrative and explicit instruction on the software that must be delivered via bite-sized segments where the students must practice each statistical test or procedure after receiving a specific segment output. The practice must be done with the guidance and support of the teacher(s) before they learn to tackle the tests independently. It is also of paramount importance to allocate time and resources for students to download and install the software prior to instruction. Their background knowledge on statistics must also be activated and reinforced at the beginning of an instruction so they are better prepared to concentrate and digest the topic well. Vocational college students must master statistical literacy and they must be able to use at least several statistical operations using statistical software such as SPSS in their learning especially in their final year project data analysis and presentation and be able to interpret and explain them. Similarly, vocational college teachers especially those who are tasked to teach final year projects must acquire a certain level of mastery on statistics and the software used for the operations.

References

Archer, A. L., & Hughes, C. A. (2011). Explicit instruction: Effective and efficient teaching. New York: Guilford Press.

Association for Talent Development (n.d.). What Is Microlearning. Retrieved from https://www.td.org/talent-development-glossary-terms/what-is-microlearning

Ben-Zvi D, Gravemeijer K, Ainley J (2018). Design of statistics learning environments. In International Handbook of Research in Statistics Education (ed by Ben-Zvi D, Makar K, Garfield J), Springer. 473-502.

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3, 77-101.

Carter, J. W. & Youssef-Morgan, C. (2022). Psychological capital development effectiveness of face-to-face, online, and Microlearning interventions Education and Information Technologies, 10.1007/s10639-021-10824-5 (https://doi.org/10.1007/s10639-021-10824-5)

Davidson, H., Jabbari, Y., Patton, H., O'Hagan, F., Peters, K., and Cribbie, R. (2019) 'Statistical Software Use in Canadian University Courses: Current Trends and Future Directions', Teaching of Psychology, Vol. 46, No. 3, pp. 246–250. https://doi.org/10.1177/0098628319853940

Fletcher, J., Lyon, G. R., Fuchs, L., & Barnes, M. A. (2019). *Learning disabilities: from identification to intervention* (pg.99). New York: The Guilford Press.

Henshaw, P. (2023). I do-we do- you do: learning more with metacognition. SecEd. Retrieved from https://www.sec-ed.co.uk/content/best-practice/i-do-we-do-you-do-learning-more-with-metacognition/

Kovacs, P., Kuruczleki, E. Kazar, K. Liptak, L, Racz, T. (2021). Modern Teaching Methods in Action in Statistical Classes, 31 (3), 899 – 919.

Kumar, A. (2024). Understanding Statistical Analysis: Techniques and Applications. Simplilearn. Retrieved from https://www.simplilearn.com/what-is-statistical-analysis-article

Martin, C. (2024). Why Is Statistical Analysis Important in Research? Julius. Retrieved from https://julius.ai/articles/importance-statistical-analysis-research

Mazouchová A., Jedličková T., Hlaváčová L. (2021) 'Statistics Teaching Practice at Czech Universities with Emphasis on Statistical Software', Journal on Efficiency and Responsibility in Education and Science, vol. 14, no. 4, pp. 258-269. http://dx.doi.org/10.7160/eriesj.2021.140405

Morris, V. (2023). I do, we do, you do: introducing new learning. Atom Learning. Retrieved from https://atomlearning.com/blog/gradual-release-of-responsibility

Rosenshine, B. (1987). Explicit teaching and teacher training. *Journal of Teacher Education, 38*(3), 34-36

Takaria, J. (2010). Penerapan RME dalam pembelajaran statistika berbasis budaya Lease Maluku. Prosiding PGSD FKIP Unpatti.

Taylor, A. & Hung, W. (2022). The effects of microlearning: A scoping review. Educational Technology Research and Development, 10.1007/S11423-022-10084-1 (https://doi.org/10.1007/S11423-022-10084-1)

Yuniawatika (2018). Statistical literacy and its urgency for students. Advances in Social Science, Education and Humanities Research, 269, 170- 173.

Appendix A

Photos of the Statistical Analysis Workshop for students and teachers

Photo 1: The trainer demonstrating the use of the software to the students

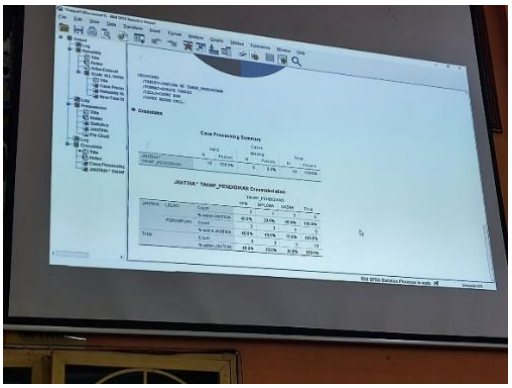


Photo 2: The projected display of the software being used with a given set of data

Photo 3: The students were expected to practice in computing the data with the support of several teachers

Photo 4-5: a workshop on statistics specifically for teachers

Appendix B

Students' samples of statistical operations in their final year project report after the workshop was conducted

4.6 STATISTIK SKALA (SPSS)

Dalam kajian ini, ujian kebolehpercayaan telah dijalankan menggunakan pekali (*Cronbach's Alpha*) untuk menilai konsistensi dalaman instrumen soal selidik yang digunakan. Jadual di bawah menunjukkan hasil analisis kebolehpercayaan:

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.720	.718	7

Berdasarkan keputusan yang diperoleh, nilai (*Cronbach's Alpha*) adalah 0.720, yang menunjukkan tahap kebolehpercayaan yang boleh diterima. Menurut Nunnally (1978), nilai (*Cronbach's Alpha*) melebihi 0.7 dianggap sebagai boleh diterima dan mencerminkan tahap konsistensi dalaman yang baik bagi item-item dalam soal selidik ini. Nilai ini menunjukkan bahawa soal selidik yang digunakan mempunyai kestabilan dan kebolehpercayaan yang baik, membuktikan bahawa item yang dikaji saling berkaitan dalam mengukur konsep yang dimaksudkan.

4.6.1 RINGKASAN PEMPROSESAN KES (CASE PROCESSING SUMMARY)

Jadual di bawah menunjukkan ringkasan pemprosesan kes dalam kajian ini:

Case Processing Summary

		N	%
Cases	Valid	5	100.0
	Excluded[a]	0	.0
	Total	5	100.0

a. Listwise deletion based on all variables in the procedure.

Berdasarkan jadual di atas, sebanyak 5 kes yang valid (100%) telah digunakan dalam analisis, dan tiada kes yang dikecualikan (0%). Ini menunjukkan bahawa semua data yang dikumpulkan adalah lengkap dan tiada nilai yang hilang. Prosedur yang digunakan dalam analisis ini adalah "listwise deletion", yang bermaksud hanya responden yang memberikan jawapan lengkap bagi semua pembolehubah yang dikaji dimasukkan dalam analisis. Oleh itu, keputusan yang diperoleh adalah berdasarkan kesemua 5 responden yang valid tanpa sebarang data yang dibuang atau diabaikan.

4.6.2 STATISTIK ITEM (ITEM STATISTICS)

Jadual di bawah menunjukkan nilai min (Mean) dan sisihan piawai (Standard Deviation) bagi setiap item yang dinilai dalam kajian ini:

Item Statistics

	Mean	Std. Deviation	N
S1	4.40	.548	5
S2	4.20	.447	5
S3	4.20	.447	5
S4	4.20	.447	5
S5	4.40	.548	5
S6	4.40	.548	5
S8	4.40	.548	5

Inter-Item Correlation Matrix

	S1	S2	S3	S4	S5	S6	S8
S1	1.000	-.408	.612	.612	.167	1.000	.167
S2	-.408	1.000	-.250	-.250	.612	-.408	.612
S3	.612	-.250	1.000	1.000	.612	.612	-.408
S4	.612	-.250	1.000	1.000	.612	.612	-.408
S5	.167	.612	.612	.612	1.000	.167	.167
S6	1.000	-.408	.612	.612	.167	1.000	.167
S8	.167	.612	-.408	-.408	.167	.167	1.000

Berdasarkan jadual di atas, terdapat hubungan positif dan sederhana hingga tinggi antara kebanyakan item, yang menunjukkan bahawa soal selidik ini mempunyai konsistensi dalaman yang baik. Walau bagaimanapun, terdapat beberapa hubungan negatif yang menunjukkan bahawa sesetengah item mungkin tidak berkaitan secara langsung antara satu sama lain.

4.6.4 STATISTIK ITEM-TOTAL (ITEM-TOTAL STATISTICS

Jadual di bawah menunjukkan statistik item-total bagi setiap item dalam soal selidik. Statistik ini membantu menilai sumbangan setiap item terhadap kebolehpercayaan keseluruhan berdasarkan nilai korelasi dan perubahan dalam nilai (*Cronbach's Alpha*) jika item dipadamkan.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
S1	25.80	3.200	.612	.	.637
S2	26.00	4.500	.000	.	.773
S3	26.00	3.500	.598	.	.651
S4	26.00	3.500	.598	.	.651
S5	25.80	3.200	.612	.	.637
S6	25.80	3.200	.612	.	.637
S8	25.80	4.200	.089	.	.771

Item S2 dan S8 mempunyai korelasi item-total yang sangat rendah (0.000 dan 0.089), yang menunjukkan bahawa kedua-dua item ini tidak berkaitan dengan skala keseluruhan. Jika dipadam, kebolehpercayaan soal selidik (*Cronbach's Alpha*) meningkat, menunjukkan bahawa membuang item ini boleh meningkatkan kesahihan dan kebolehpercayaan soal selidik.

Item S1, S3, S4, S5, dan S6 mempunyai korelasi item-total yang baik (≥ 0.598), yang menunjukkan bahawa item ini sesuai dikekalkan dalam soal selidik kerana ia berkorelasi dengan baik dengan skala keseluruhan.

Nilai (*Cronbach's Alpha*) selepas membuang item tertentu menunjukkan sedikit peningkatan atau penurunan, yang memberikan gambaran tentang sumbangan setiap item terhadap kebolehpercayaan soal selidik.

4.6.4 STATISTIK SKALA (SCALE STATISTICS)

Jadual di bawah menunjukkan statistik skala keseluruhan bagi soal selidik yang digunakan dalam kajian ini. Statistik ini merangkumi min, varians, sisihan piawai, dan jumlah item dalam skala.

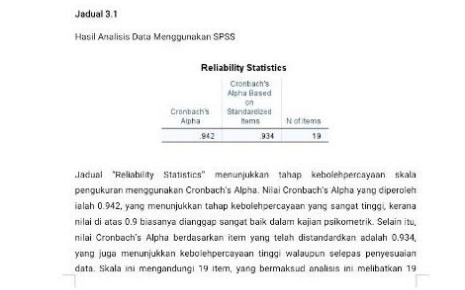
Scale Statistics

Mean	Variance	Std. Deviation	N of Items
30.20	4.700	2.168	7

Nilai min 30.20 menunjukkan purata jawapan responden bagi skala ini.

Sample 1: These students from Welding Technology used reliability statistics, Cronbach's Alpha, as well as item statistics, inter-item correlation matrix, item-total statistics and scale statistics in determining the reliability and cohesiveness of their panel evaluation items as well as the rating of the panel which comprised five assessors.

Sample 2: Similarly, these students from Automotive Technology examined the credibility of their evaluation items as well as the responses from the panel with similar statistical tests.



Sample 3: A student from Construction Technology used reliability statistics and scale statistics to determine the reliability of the items and data set gathered from the assessors.