

Decoding the Future: Exploring University Students' Perspectives on Data Literacy and Employability

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ABSTRACT

This research investigates university students' perceptions of data literacy and its relevance to their employability. The study reveals an increasing awareness among students of the need and benefits of being data literate, particularly in the modern job market. It emphasizes that data literacy not only improves job prospects but also provides a competitive advantage in a data-driven professional environment. From the research, it is evident that the organizations that have transformed their operation to depend on data prefer those employees with data and statistical knowledge. The study also reveals the significance of self-directed learning to data literacy in sustaining market competitiveness. Students' survey result indicates shared understanding of the importance of data literacy to succeed in the society dominated by data and the practical value of the skills in gaining employment. In the same way, the findings also reflect a division in students' confidence in their data literacy skills, with some feeling proficient and others recognizing their skill gaps. However, the majority of the students claim their educational institutions provide adequate means for building data literacy skills and appreciate guidance from experienced educators.

Keywords: data industry, data literacy, employability, job market, university

INTRODUCTION

Data literacy, as defined by Frank et al. (2016), is the ability to comprehend and utilize data effectively. It goes beyond information processing where it involves extracting valuable insights from data to make it beneficial. In the fourth industrial revolution and data-driven economy, data literacy has become essential for survival and success across sectors. This skill helps the organization to gather and analyze user or customer data for the purpose of decision making, thus enhancing the company's revenue and customer satisfaction levels. The rise of big data in decision-making processes has made data literacy a key qualification for many professions. Skills in computing, programming, and data literacy are increasingly valued in enhancing employee marketability (Peter and Gomez, 2019; Mahmud et al., 2022).

Persaud's (2020) study highlighted the demand for workers adept in data literacy, computing, and possessing specific social skills and personality traits. Hadromi et al. (2019) emphasized the integration of data, technological, and human literacy in vocational education, preparing students to be competitive and proficient. Sasikala & Dhanraju (2011) pointed out the importance of embedding statistics and information literacy in higher education to help students understand the role of information in society and maintain ethical standards.

In sectors like sports, hospitality, banking, and finance, data literacy is increasingly recognized as vital. Kjellvik & Schultheis (2019) noted the growing importance of data in society, making data literacy essential for students preparing for careers both within and beyond STEM fields. However, awareness of data literacy's role in enhancing employability is not widespread beyond these industries. Johannssen et al. (2021) demonstrated

that statistical literacy involves not only basic statistical analysis skills but also higher-order cognitive abilities. Unfortunately, many students and teens lack the necessary information skills for academic success in university environments, struggle with using databases for research (Salisbury and Karasmanis, 2013), and find it challenging to connect with data on a personal level despite understanding its lifecycle (Bowler et al., 2017).

Figure 1 shows the core components of data literacy skills and competencies. It is segmented into three main areas: data application, data management, and data evaluation. data application encompasses aspects of critical thinking, the evaluation of decisions, the sharing and utilization of data, and data ethics. Data management is concerned with the creation, collection, and extraction of data, as well as its preservation, organization, storage, and the use of data security measures and metadata. Finally, Data evaluation focuses on the ability to make decisions based on data, analysis using basic tools, the presentation of data, and the identification of problems. Each area is interconnected, highlighting the comprehensive and multifaceted nature of data literacy.

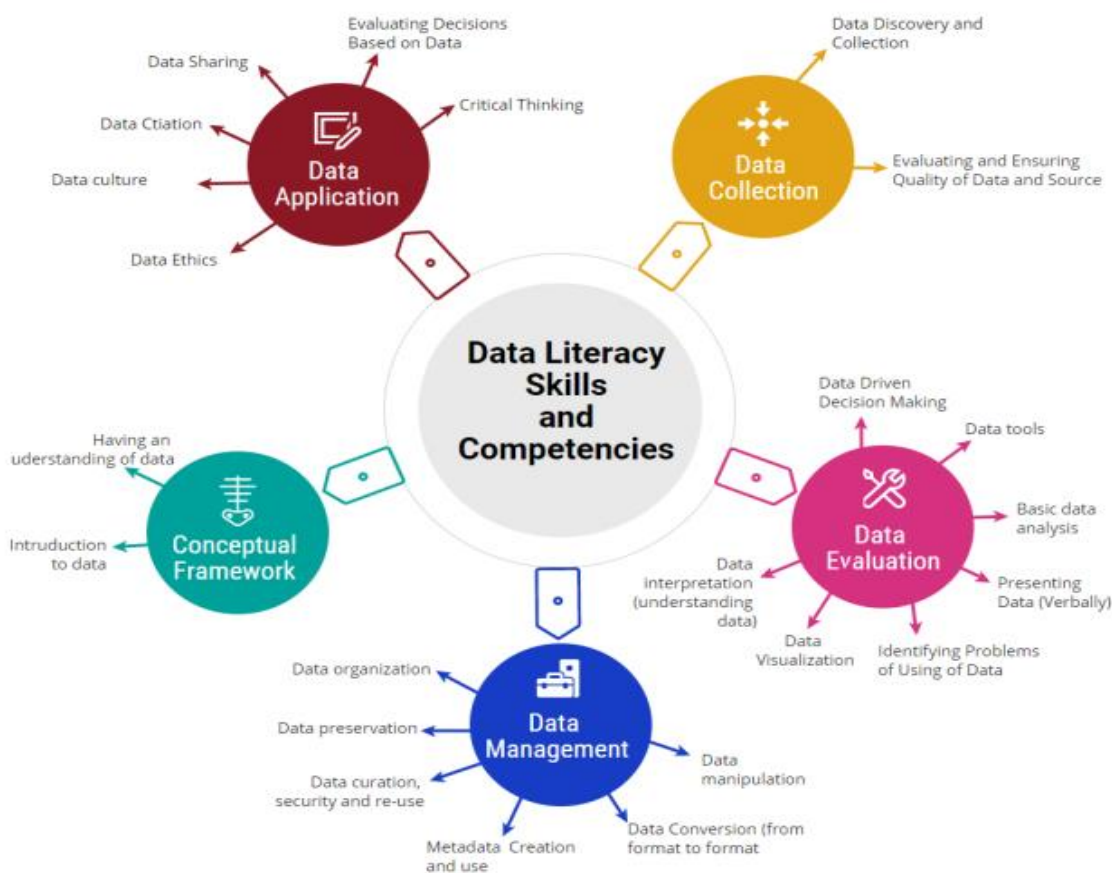


Figure 1: Data Literacy Competencies by Ridsdale et. al. (2015, p. 38)

While the data industry widely recognizes the importance of data literacy, there is a noticeable shortage of insights from university students on this topic. Academic research seldom explores how these students perceive data literacy skills and their impact on job prospects. This study aimed to bridge this gap by investigating university students' views on data literacy and its relevance to their employability. Additionally, it sought to educate students about the various benefits that data literacy offers.

LITERATURE REVIEW

In today's globalized era, merely having technical skills specific to a job is insufficient for recent graduates. Employers now expect additional skills to ensure graduates are capable of handling their roles (Suartha et al., 2017). With the advent of a data-driven society, data literacy has become a vital complementary skill, enhancing employability chances. Pothier and Condon (2019) noted that companies aim to be data-centric, which necessitates data-literate employees for efficient and cost-effective decision-making.

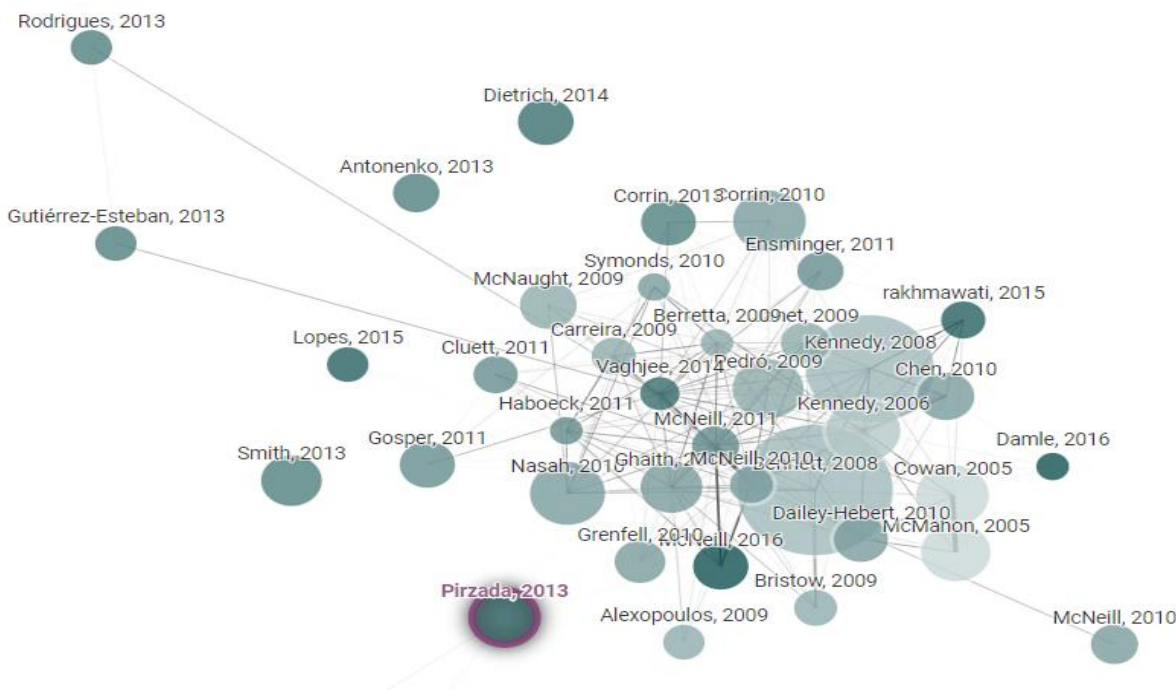


Figure 2: Data Literacy Competencies

In the 21st century, data literacy has emerged as a key trend. Figure 2 illustrates a network of scholarly citations, mapping the interconnectedness of authors' works in the field of data literacy and competencies, with each node denoting an author and their key publication by year. The varying node sizes imply the frequency of citations, with "Pirzada, 2013" being particularly prominent, indicating its significance within the network. The spread of years from 2005 to 2016 across the nodes illustrates the temporal evolution of academic discourse and contributions in the field.

Governments and educational institutions are starting to recognize the importance of introducing data literacy from elementary education onwards (Mahmud and Wong, 2022a). Schools, as primary knowledge sources, should collaborate with the Ministry of Education to integrate data-related subjects into the curriculum. Wolff et al. (2016) stressed the importance of including data literacy in education to ensure future societal data literacy. François et al. (2020) argued that educators are responsible for equipping future professionals with essential data literacy skills and interdisciplinary competencies. Introducing basic statistical subjects at primary and secondary levels is critical to developing foundational knowledge. The interest in data sharing in the commercial world, as discussed by Robertson and Tisdall (2020), suggests that data literacy education would be well-received if included in school curricula. Dichev and Dicheva (2017) found that universities integrating data subjects prepare students better for the professional world, suggesting the inclusion of advanced topics like time series and Bayesian forecasting.

In the context of the Industrial Revolution 4.0, organizations increasingly rely on big data for decision-making. This shift has heightened the preference for employees with digital skills, including data literacy (Bejaković and Mrnjavac, 2020; Kim, 2019; Lissitsa and Chachashvili-Bolotin, 2019; Pirzada and Khan, 2013; Mahmud and Wong, 2022b). Such skills are crucial for graduates, particularly as a compensatory factor for the lack of work experience. However, Kim (2020) noted that while core competencies impact employability, digital skills alone do not suffice. This indicates the need for continuous learning, especially in rapidly evolving fields like programming.

Integrating data literacy into the education system presents challenges. According to Carlson and Bracke (2015), and Tsai and Gasevic (2017) cited similar concerns raised by students including low confidence, vulnerability, and limited orientation on data competencies. Furthermore, the existing curriculum structure and educator competencies in data literacy are often inadequate (Van Audenhove et al., 2020; Deahl, 2014; Kennedy-Clark et al., 2020). Meeting these challenges calls for schools and universities to ensure educators effectively trained in fundamental areas of relevance subjects as well as offering student adequate practice data

literacies. The current level of data literacy among graduates often falls short of industry demands (Ridsdale, 2015; Oguguo et al., 2020). While some students excel in data handling, many lack adequate data literacy skills, hindering their employability (Otto, 2012; Zoellick et al., 2016; Squibb and Mikkelsen, 2016). This disparity highlights the need for more focused education in data and statistics at the university level to meet the required proficiency standards.

From the perspective of graduates entering the profession, the current level of data skills they bring to the job is still below optimal (Ridsdale, 2015; Oguguo et al., 2020). Despite the fact that the performance of some students in data analysis courses is satisfactory, most of them fail to meet the fundamental data analysis skills that would improve their marketability in the job market (Otto, 2012; Zoellick et al., 2016; Squibb et al., 2016). This gender difference makes it necessary to further enhance the instruction of data and statistics in university level in order to meet the identified proficiency demands.

MATERIALS AND METHODS

This research used a quantitative research approach, where the survey was developed based on previous research and literature, with a 5-point Likert scale. The survey explored four key areas: the importance of data literacy, its impact on employability, challenges faced by students in acquiring data literacy, and the level of data literacy among university students. The questions in the survey format were segregated into five parts. The first part of the questionnaires was collecting demographic data on the participants. The remaining four sections addressed specific topics: the importance of data literacy, its influence on employability, challenges in acquiring data literacy skills among students, and the current level of data literacy among university students.

The analysis involved a frequency distribution, which provided a summary of how many students recognized the importance of data literacy, faced challenges in data literacy, believed in the usefulness of data literacy skills for employment, and agreed on the necessity of data literacy skills for university students. The average awareness and perceived usefulness of data literacy skills among students were calculated using the mean. The sample standard deviation was employed to determine the variability in responses. A high standard deviation indicated a wide range of responses, while a low standard deviation suggested a concentration of responses near the mean.

A purposive sampling method was used, targeting university students primarily within the 18-25 age range. The survey was conducted between June 17 and June 21, 2022, with 100 respondents participating. The research commenced with a review of numerous studies on data literacy, leading to the definition of the research topic and objectives. The research method and sample were then determined, and the survey was designed. The collected data were stored automatically and analyzed using Microsoft Excel.

RESULT AND DISCUSSION

Demographic Information

The gender distribution among the 100 survey participants: 51 females and 49 males. The predominant age group was 19 years (27 males, 30 females), followed by 20-year-olds (18 males, 12 females). The least represented age was 18, with only two participants (1 male, 1 female). The average age across respondents was 19.5 years. Table 1 displays the distribution of respondents across various majors. Actuarial Studies was the most represented major with 21 participants, followed by Computing with 19, and Industrial Statistics with 15. Other disciplines such as International Relations, Engineering, and Fintech were categorized under 'Others'.

Table 1: Demographic Information

Major	Quantity
Industrial Statistics	15
Actuarial Studies	21
Finance	14
Computing	19

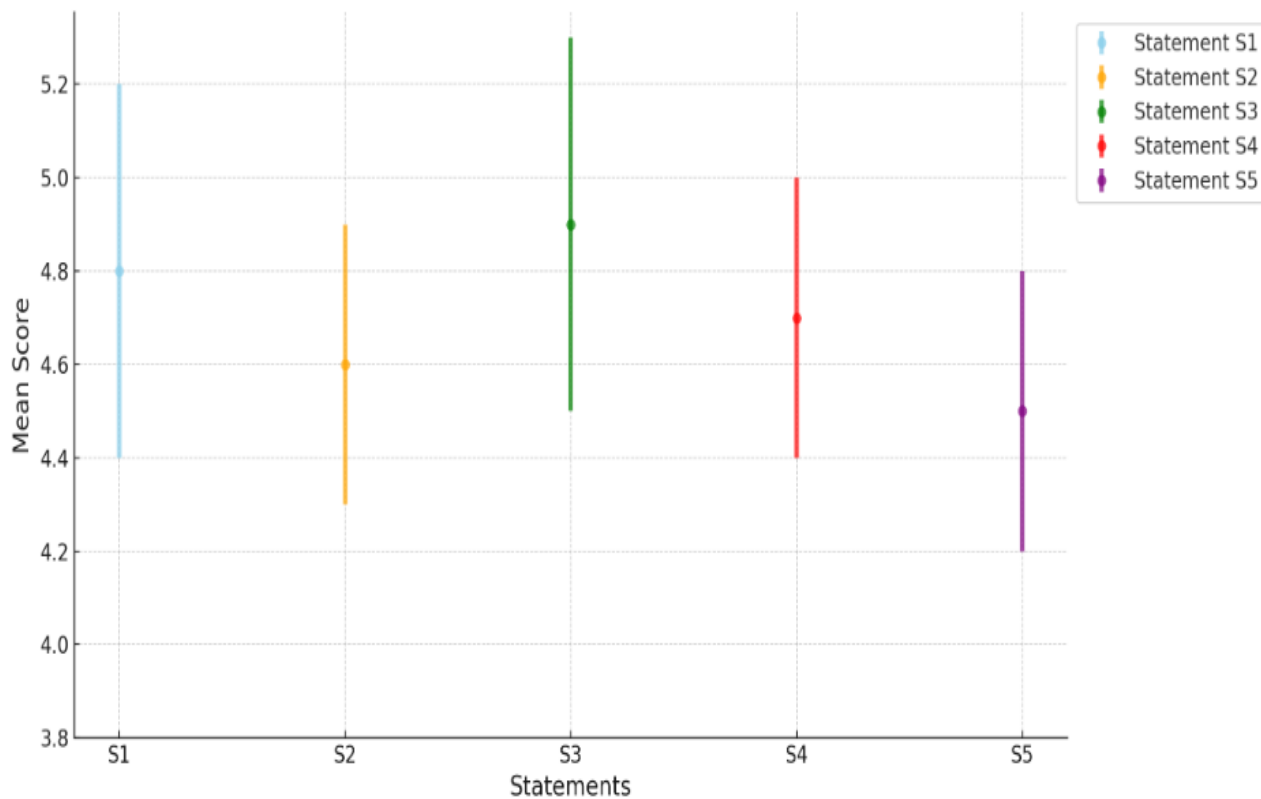
Accounting	12
Medical	7
Business	5
Others	7

Importance of Data Literacy

According to Table 2, a significant number of respondents acknowledged the importance of data literacy in various aspects. For S3, 97 participants (36 agreeing, 61 strongly agreeing) recognized data literacy as a crucial skill in a data-driven society. Similarly, for S1, 97 respondents (46 agreeing, 51 strongly agreeing) believed in the necessity of data skills for future statisticians. Additionally, 92 participants concurred that learning data literacy enhances decision-making abilities (S4). The mean scores for all statements exceeded 4, indicating a general consensus on the value of data literacy. These results align with Gibson and Mourad (Gibson and Mourad, 2018), who emphasized preparing students for a data-rich future. The vertical error on Bar Chart 1 presents the mean scores for five statements on the importance of data literacy, likely derived from a survey. The mean scores range from approximately 4.36 to 4.58. Error bars indicate the standard deviation for each statement's score, suggesting the spread of the responses.

Table 2: Importance of Data Literacy

	<i>Statements</i>	<i>SD</i>	<i>D</i>	<i>N</i>	<i>A</i>	<i>SA</i>	<i>Mean</i>	<i>Std Dev</i>
S1	Data skills and interdisciplinary competencies	0	0	3	46	51	4.48	0.5592
S2	Data drives discovery, decision-making and innovation	0	0	7	45	48	4.41	0.6211
S3	Data literacy skill in the data-driven society	0	0	3	36	61	4.58	0.5538
S4	Learning data literacy and decision making	0	0	8	39	53	4.45	0.6416
S5	The role of data and data science	0	0	11	42	47	4.36	0.6745



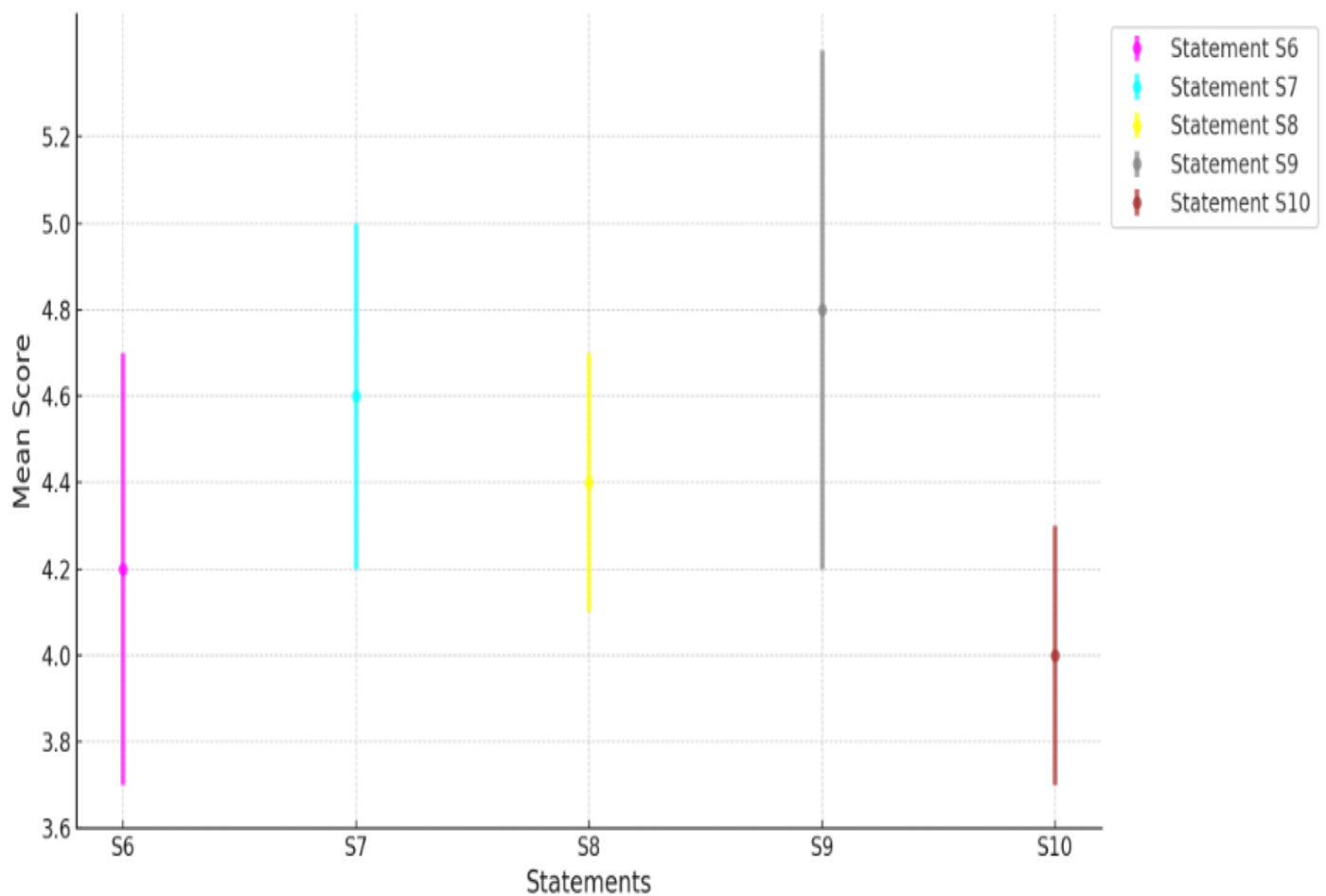
Bar Chart 1: Importance of Data Literacy

Table 3 explores data literacy in relation to employability. A majority of respondents (55 for S6, 60 for S7, 59 for S9, and 56 for S10) strongly agreed on the importance of data literacy for job prospects and professional

decision-making. The responses to S8, however, were more varied, suggesting that not all participants viewed data visualization and interpretation skills as definitive factors for employment. The vertical error bars on Bar Chart 2 illustrate the mean scores for five statements regarding data literacy and its impact on employability. The mean scores fluctuate from just under 4.2 to around 4.8. Error bars represent the standard deviation for each statement's score, reflecting the distribution of respondents' opinions.

Table 3: Data Literacy and Employability

	Statements	SD	D	N	A	SA	Mean	Std Dev
S6	Data literacy and employability opportunity	0	2	11	32	55	4.40	0.7654
S7	Data literacy in professional world	0	0	1	39	60	4.59	0.5143
S8	Graduates and data visualization skills	0	1	8	46	45	4.35	0.6723
S9	Decisions making and data literacy skills	0	1	5	35	59	4.52	0.6432
S10	Employees and usage of data	0	0	7	37	56	4.49	0.6276



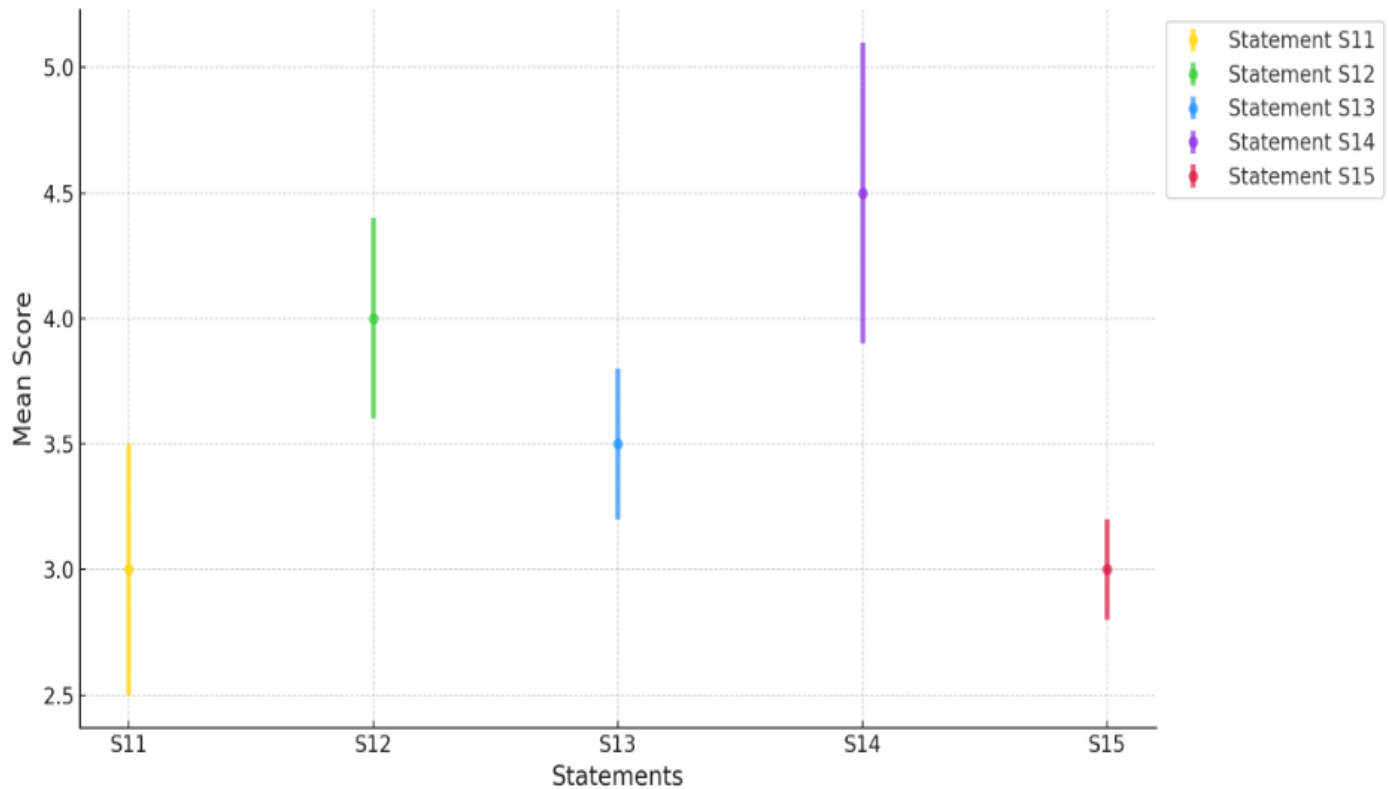
Bar Chart 2: Data Literacy and Employability

Challenges of Data Literacy Among Students

Table 4 also sheds light on the challenges students face in acquiring data literacy. While 73 respondents felt confident in presenting data (S11), opinions were divided on their overall confidence in data literacy skills (S12). A majority believed their educational institutions provided sufficient resources for data literacy development (S13), but the complexity of data literacy concepts (S14) and the need for guidance in learning (S15) were noted as significant challenges. Bar Chart 3, labeled features vertical error bars indicating the mean scores of statements S11 through S15. The mean scores range broadly from just over 3.0 to just under 5.0. The error bars signify the standard deviations, showcasing the spread of responses for each statement and suggesting varying levels of consensus among the responses.

Table 4: Challenges

	<i>Statements</i>	<i>SD</i>	<i>D</i>	<i>N</i>	<i>A</i>	<i>SA</i>	<i>Mean</i>	<i>Std Dev</i>
S11	Data presentation as information	0	8	19	34	39	4.04	0.9526
S12	Knowledge and data literacy skills	3	6	19	38	34	3.94	1.0232
S13	Resources/tools to improve data literacy skills	1	5	16	41	37	4.08	0.9065
S14	Concepts and basics of data literacy	2	18	23	27	30	3.65	1.1492
S15	Guidance and data literacy skills	0	11	14	32	43	4.07	1.0076



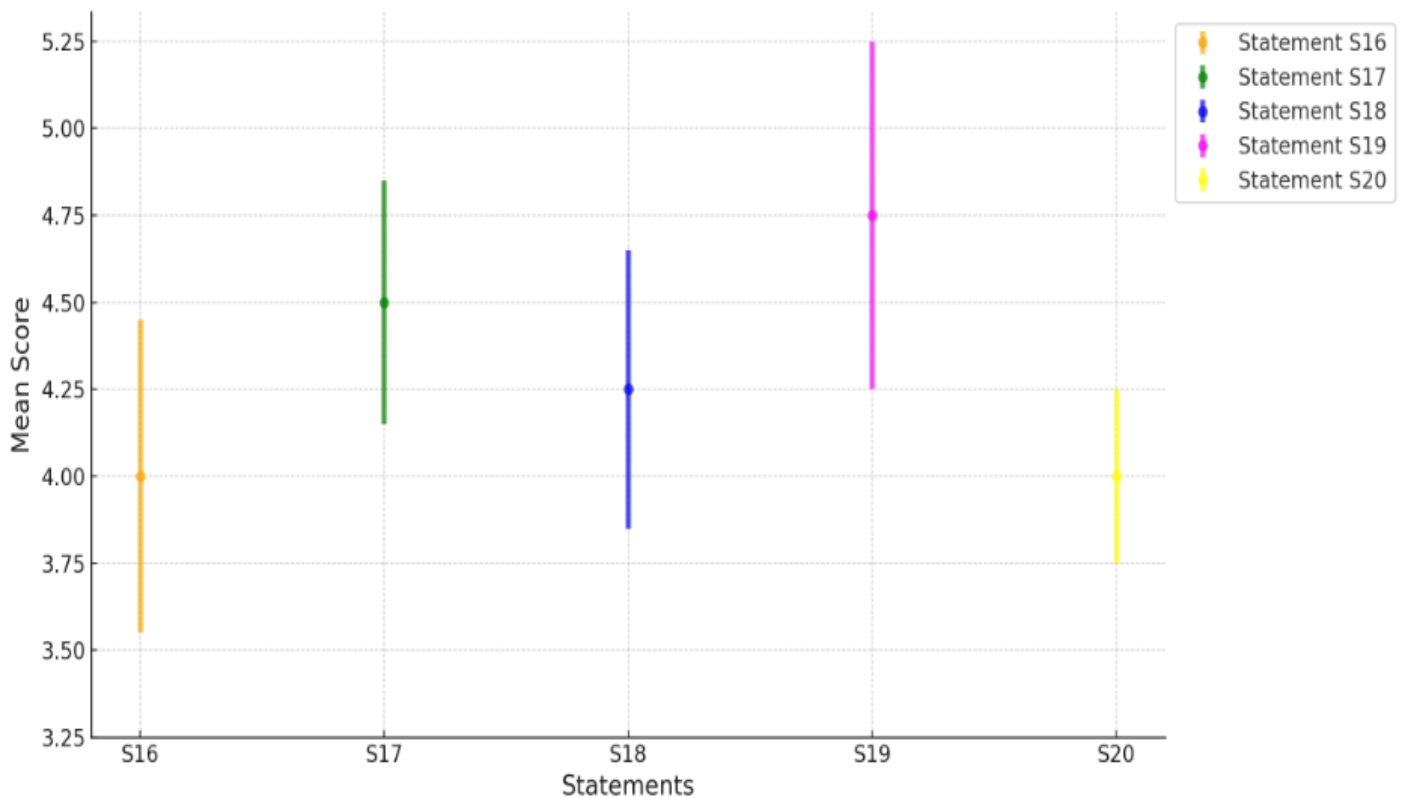
Bar Chart 3: Challenges

Data Literacy Among University Students

Finally, Table 5 indicates that most university students recognize the inclusion of data literacy in their courses (S16) and the crucial role of higher education in acquiring these skills (S17). A substantial number of students believed they possess basic data literacy skills necessary for the workplace (S18, S19). Additionally, there was strong support for integrating data literacy skills into the curriculum at earlier educational stages (S20). Bar Chart 4 showcases vertical error bars reflecting the mean scores for statements S16 through S20. The scores vary from just above 4.0 to roughly 5.0. The error bars indicate standard deviations, illustrating the distribution of the survey responses around the mean. Bar Chart 4 features vertical error bars representing the mean scores of statements S16 through S20. The mean scores span from above 4.0 to close to 5.0, with error bars depicting the standard deviations, signifying the degree of agreement among the respondents' ratings.

Table 5: Data Literacy Among University Students

	<i>Statements</i>	<i>SD</i>	<i>D</i>	<i>N</i>	<i>A</i>	<i>SA</i>	<i>Mean</i>	<i>Std Dev</i>
S16	Data literacy in university program	0	9	9	31	51	4.24	0.9547
S17	University role and data literacy	0	1	6	46	47	4.39	0.6497
S18	Skills visualizing data	0	6	14	33	47	4.21	0.9022
S19	Data literacy skills and visualization/interpretation	0	0	7	39	54	4.47	0.6269
S20	Data literacy skills in school syllabus	0	0	10	38	52	4.42	0.6694



Bar Chart 4: Data Literacy Among University Students

DISCUSSION

The study concludes that data literacy is increasingly recognized as vital for employability in a data-driven society. University students acknowledge its importance and are keen on developing these skills, albeit facing challenges in the learning process. The study also notes demographic limitations, particularly in age diversity and academic disciplines, suggesting the need for broader future research to capture a more comprehensive view of data literacy perceptions and its impact on employability.

CONCLUSION

This study explored the perception and significance of data literacy among university students, particularly in relation to their employability. The investigation revealed a growing awareness among students of the necessity and advantages of being data literate in the contemporary job market. This research underscored that data literacy not only enhances the likelihood of securing employment but also fosters a competitive edge in a rapidly evolving, data-centric professional landscape. From an organizational perspective, candidates possessing knowledge in data and statistics are increasingly favored, aligning with the trend of companies striving towards data-centric operations. The study also highlighted the critical role of self-directed learning in data literacy, emphasizing its importance in maintaining competitiveness in the job market. The survey findings indicated a consensus among university students on the importance of data literacy in navigating a data-driven society. In terms of employability, respondents largely agreed that data literacy skills are instrumental in enhancing job prospects. The study also identified a dichotomy in students' confidence in their data literacy skills, with some expressing proficiency while others perceive gaps in their abilities. However, the majority believed that their educational institutions provide adequate resources to support their development in data literacy, suggesting a potential pathway to address these skill gaps. Furthermore, guidance from experienced educators is seen as a valuable component in their data literacy journey.

The study also revealed that a significant portion of university students currently possess or are acquiring data literacy skills through their academic programs. However, the survey faced limitations in terms of demographic diversity, particularly in age groups and academic disciplines. The majority of respondents were

from fields where data literacy is likely an integral part of the curriculum, such as Actuarial Studies, Computing, and Industrial Science. This limits the breadth of insights regarding data literacy perceptions among students from other disciplines less immersed in data-oriented subjects. To address these limitations, future research should endeavor to reach a broader demographic, utilizing online platforms and social media to engage a more diverse population of university students. By capturing a wider range of perspectives, subsequent studies can offer a more comprehensive understanding of the role of data literacy in employability and the diverse educational needs of students across various academic fields.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical approval and informed consent statements

This study was conducted following the ethical standards of Sunway University. All procedures were conducted in accordance with institutional guidelines.

All participants were provided with detailed information about the purpose of the study, procedures, and their rights as participants, including the right to withdraw at any time without penalty. Informed consent was obtained from each participant prior to their inclusion in the study. Participants' responses were anonymized, and all data were handled confidentially.

Missing data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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