

DIGITAL COMPETENCE AND DATA LITERACY IN FRAUD DETECTION



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Abstract

Despite increasing digitalization in the accounting profession, limited empirical evidence explains how digital competence is transformed into effective fraud detection capability, particularly among early-career accountants. This study aims at examining the effects of digital competence and data science literacy on fraud detection skills, with diagnostic skills as a mediating mechanism among Generation Z accountants in Indonesia. Using a quantitative survey of 150 respondents and partial least squares structural equation modeling (PLS-SEM), the findings show that digital competence does not directly enhance fraud detection skills but operates through data science literacy and diagnostic skills. Diagnostic skills emerge as the key cognitive mechanism converting technological capability into fraud detection effectiveness. These results imply that accounting education and professional training should prioritize diagnostic reasoning alongside digital and analytical skills.

INTRODUCTION

Fraud in accounting remains a persistent issue that undermines the credibility of financial information and public trust. Prior literature has long recognized fraud as a systemic and recurring phenomenon across both the public and private sectors, emphasizing the need for continuous improvement in detection and prevention mechanisms (Yeni Priatnasari et al., 2020). According to the 2024 report by the Association of Certified Fraud Examiners (ACFE), global businesses experience an estimated annual revenue loss of about five percent as a result of fraudulent activities. The Asia-Pacific

region recorded the second-highest average loss per case, with Indonesia ranking third, following China and Australia (Hilal et al., 2022). These findings underscore the pressing need to enhance accountants' competence as gatekeepers of financial integrity, as fraud undermines investor confidence, triggers market instability, and erodes corporate reputation (Zhao et al., 2021). Accordingly, auditors and accountants are positioned as key gatekeepers of financial integrity, with professional judgment and ethical responsibility playing a central role in fraud prevention and detection (Zhao et al., 2021).

The swift evolution of digital technologies increasingly intensifies the complexity of detecting fraud. The emergence of big data, blockchain, and artificial intelligence has transformed business transactions while also generating new risks, such as cyber fraud and data manipulation (Adam & Fazekas, 2021). Earlier fraud detection studies primarily emphasized forensic accounting techniques and compliance-based controls, which, although effective, showed limitations when confronting increasingly complex and technology-driven fraud schemes (Zhao et al., 2021). Conventional audit techniques that rely on manual documentation are no longer adequate for identifying anomalies hidden in complex datasets (Zhao et al., 2021). Therefore, accountants are expected to acquire a combination of data science literacy (DSL), digital competence (DC), and diagnostic skills (DS) that allow them to interpret data effectively and detect fraud more accurately (Tutino & Merlo, 2019).

Prior empirical studies examining fraud detection competencies in accounting can be broadly classified into three thematic streams. While these streams provide valuable insights, they also revealed important conceptual and empirical limitations that constrained a comprehensive understanding of fraud detection in digitally intensive environments.

The first stream emphasizes the role of digital competence and technological tools in enhancing audit efficiency and anomaly detection. Studies demonstrated that audit analytics, automation, and forensic technologies improved auditors' capacity to process complex financial information (Handoko et al., 2020; Li et al., 2019; Tutino & Merlo, 2019). However, this stream predominantly conceptualized technology as a technical input and largely overlooked the cognitive mechanisms through which digital capability is translated into professional judgment. As a result, existing studies provided a limited explanation of how and under what conditions DC actually improved fraud detection outcome (Adam & Fazekas, 2021; Zhao et al., 2021).

The second research stream emphasized data science literacy (DSL) and analytical competencies, underscoring the critical role of big data analytics, predictive modeling, and data visualization in enhancing fraud detection capabilities (Al, 2021; Bose et al, 2023). While this literature confirmed the analytical value of data-driven approaches, empirical findings remained inconsistent regarding whether data literacy alone was sufficient to enhance fraud detection performance. Several studies reported that analytical capability did not automatically translate into improved fraud judgment, particularly among early-career accountants with limited experiential knowledge (Kroon et al., 2021; Kassem & Omoteso, 2023). This inconsistency suggested that DSL might require complementary cognitive skills to become operationally effective.

The third stream highlighted DS, professional judgment, and analytical reasoning as critical determinants of fraud detection effectiveness (Bakumenko & Elragal, 2022). Nevertheless, this body of research tended to treat DS as relatively static individual attributes, paying limited attention to how such skills were developed through exposure to digital technologies and data-driven work environments. As a result, the developmental relationship connecting digital competence, data literacy, and diagnostic reasoning had not yet been comprehensively articulated (Al-Natour, S., 2023; Tiron-Tudor et al, 2022).

Taken together, these streams revealed a clear theoretical gap. Much of the existing literature examined DC, DSL, and DS in isolation, thereby failing to capture how their interaction formed an integrated capability underpinning effective fraud detection (Kroon et al., 2021; Tiron-Tudor et al, 2022; Tutino & Merlo, 2019). Moreover, empirical evidence remained scarce for Generation Z accountants in developing economies such as Indonesia, where high digital familiarity often coexisted with limited professional experience (Bandura, 1977; Handoko et al, 2020). This fragmented approach restricted theoretical understanding of how technological competence was cognitively transformed into fraud detection capability, thereby motivating the present study.

In this study, Generation Z accountants were conceptually defined as individuals born in the mid-1990s onward who had completed formal accounting education and were either entering or at an early stage of their professional careers. This cohort was characterized by high exposure to digital technologies and data-driven environments, yet relatively limited professional experience in complex fraud investigation and judgment-intensive accounting contexts (Kroon et al., 2021; Dzurinin, Jones, 2018). Consistent with this characterization, recent studies showed that Generation Z accounting students and early-career professionals increasingly associated the accounting profession with digital skills, technological adaptability, and data-oriented competencies, which shaped both career motivation and professional readiness (Bandura, 1977; Wona & Wany, 2024).

Digital competence and data-driven skills were increasingly recognized as essential for modern accountants (Li, Dai, Gershberg, 2018; Tutino & Merlo, 2019). However, empirical understanding of how these competencies were translated into effective fraud detection capabilities remained limited, particularly among early-career Generation Z accountants in Indonesia (Bandura, 1977; Handoko et al, 2020).

While earlier studies explored digital technologies, data analytics, and forensic techniques as distinct domains, the combined contribution of digital competence and data science literacy to strengthening fraud detection capabilities had yet to be clearly established, particularly regarding whether their effects were direct or channeled through higher-level cognitive processes such as diagnostic reasoning (Bakumenko & Elragal, 2022; Zhao et al., 2021). This gap was especially critical in the Indonesian context, where the adoption of advanced audit technologies remained uneven, and many Generation Z accountants possessed strong digital familiarity but limited professional experience (Bandura, 1977; Handoko et al, 2020). Consequently, it remained unclear whether digital and analytical competencies alone were sufficient to strengthen fraud detection or whether diagnostic skills served as a necessary mechanism that converted technological capability into effective professional judgment. Addressing this unresolved issue constituted the central problem of the present study.

The theoretical base of this study integrated insights from Social Learning Theory, which emphasized experiential knowledge acquisition (Bandura, 1977), and Information Processing Theory, focusing on how information was encoded and utilized for judgment formation (Newell, A., & Simon, 1972; Tiron-Tudor et al, 2022). Social Learning Theory explained that individuals acquired DC and DSL through observation and practice in professional environments. Information Processing Theory focused on how individuals analyzed and interpreted information to make informed judgments. Integrating these perspectives provided a basis for understanding how DC and DSL could strengthen DS and thereby enhance FDS.

The hypothesized relationships examined in this research were grounded in the theoretical perspectives of Social Learning Theory and Information Processing Theory, which together elucidated how digital and analytical competencies were developed and subsequently manifested in effective fraud detection behavior (Bakumenko & Elragal, 2022; Bandura, 1977). Social Learning Theory argued that individuals build competencies through continuous observation, social interaction, and repeated engagement with professional tools and practices. In the accounting domain, higher levels of DC enabled individuals to more readily engage with, experiment on, and internalize advanced data-driven practices within their work environments. Accordingly, DC served as a foundational capability that enhanced DSL (Li et al., 2019; Tutino & Merlo, 2019), as digitally proficient individuals were better positioned to acquire data analytics skills, interpret complex digital information, and apply technological solutions to sophisticated accounting tasks.

In parallel, Information Processing Theory explained how individuals transformed information into meaningful judgments through cognitive mechanisms such as analysis, interpretation, and reasoning. DSL enhanced an accountant's ability to process large volumes of financial data, recognize patterns, and identify anomalies, thereby strengthening DS (Kassem & Omoteso, 2023; Tiron-Tudor et al, 2022). DS represented a higher-order cognitive capability that allowed accountants to integrate digital outputs and analytical insights into professional judgment.

Within this framework, DC and DSL did not directly translate into fraud detection effectiveness unless supported by strong diagnostic reasoning. DS served as the cognitive mechanism through which

digital and analytical inputs were evaluated, contextualized, and converted into accurate fraud-related decisions. Thus, Information Processing Theory provided a logical explanation for the mediating role of diagnostic skills in linking technological competence to fraud detection outcomes.

Taken together, these theoretical perspectives justified the proposed conceptual model by explaining how digital competence fostered learning and skill acquisition (Social Learning Theory), while data science literacy and diagnostic reasoning enabled effective information processing and judgment formation (Information Processing Theory), ultimately strengthening fraud detection capabilities among Generation Z accountants.

The findings are expected to contribute theoretically by developing an integrative model of digital and analytical competence for fraud detection and practically by offering insights for educators and professional institutions to strengthen competence-based accounting curricula.

Based on perspectives built upon prior studies and the theoretical framework, the study's conceptual framework is depicted in Figure 1.

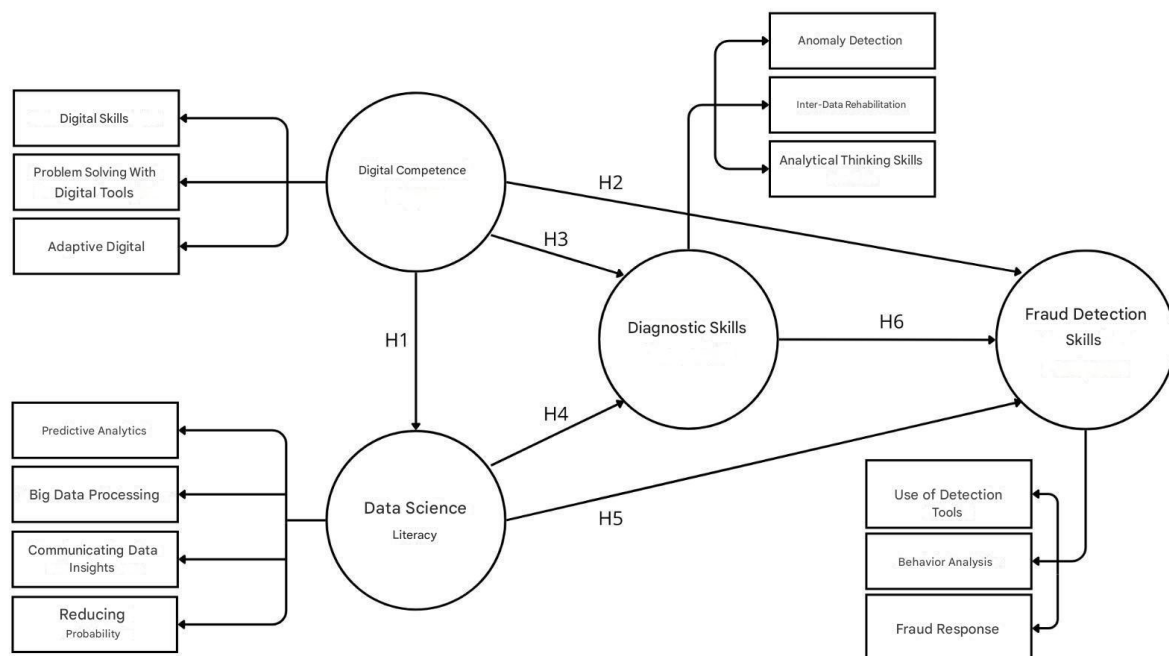


Figure 1. Framework of Research

The diagram illustrates the interrelationships among “Data Science Literacy (DSL), Digital Competence (DC), Diagnostic Skills (DS), and Fraud Detection Skills (FDS)” as conceptualized within the study framework. DC positively influences DSL, DS, and FDS, while DSL enhances both DS and FDS. DS acts as a mediating pathway linking DC and DSL to improved fraud detection among Generation Z accounting practitioners in Indonesia.

Based on the foregoing discussion, this study examines how DC and DSL affect FDS through the mediating role of DS among Generation Z accountants in Indonesia. To ensure a clear and systematic research structure, the study addresses the following research questions:

- RQ1:** “How does digital competence influence data science literacy among Generation Z accountants in Indonesia?”
- RQ2:** “How does digital competence influence diagnostic skills and fraud detection skills among Generation Z accountants?”
- RQ3:** “How does data science literacy influence diagnostic skills and fraud detection skills among Generation Z accountants?”
- RQ4:** “Does diagnostic skill mediate the relationships between digital competence, data science literacy, and fraud detection skills among Generation Z accountants?”

METHOD

This study employed a quantitative survey approach to examine the relationships among digital competence (DC), data science literacy (DSL), diagnostic skills (DS), and fraud detection skills (FDS). The respondents were Generation Z accounting professionals in Indonesia who were officially registered as members of the Indonesian Institute of Accountants (IAI). Data were gathered through a structured survey instrument distributed via purposive sampling, yielding 150 valid observations that satisfied the study's inclusion criteria.

To ensure sufficient statistical sensitivity, an a priori sample size estimation was conducted using G*Power 3.1 (Faul et al., 2007). The parameter configuration in this study assumed a medium effect size ($f^2 = 0.15$), a significance level (alpha) of 0.05, a statistical power of 0.95, and three predictor variables, which yielded a minimum required sample size of 107 respondents. To enhance the robustness of the analysis and anticipate possible data loss, the final sample was increased by approximately 40%, resulting in 150 valid responses. This sample size aligns with established best-practice guidelines for conducting Partial PLS-SEM analyses (Memon et al., 2020).

As the study employed purposive sampling focusing on early-career Generation Z accountants, the findings are intended to explain relationships within this specific group rather than support broad population-level generalizations.

Data collection was assisted by trained research assistants who were responsible for distributing the questionnaires. Before data collection, the assistants received standardized briefings regarding the study objectives, respondent eligibility criteria, and uniform procedures for questionnaire distribution. These briefings aimed to ensure consistency in data collection and minimize procedural variation across respondents. The assistants were instructed to refrain from providing interpretations of questionnaire items and to direct respondents to the standardized written instructions provided in the survey instrument.

The measurement instrument was adapted from previously validated constructs covering DC (Tutino & Merlo, 2019), DSL (Bose et al, 2023), DS (Bakumenko & Elragal, 2022), and FDS (Al-Natour, S., 2023). The instrument comprised 26 indicators assessed using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Content validity was evaluated by ten academic and professional experts in auditing, taxation, and information systems through the Item Objective Congruence (IOC) index. A pilot assessment involving 30 participants demonstrated that all measurement constructs recorded Cronbach's alpha coefficients exceeding 0.70, confirming satisfactory internal consistency and reliable instrument validity.

Furthermore, the instruments were adapted from previously validated research to maintain theoretical alignment and ensure content validity (Dzuranin, Jones, 2018; Kassem & Omoteso, 2023). The adaptation procedure entailed a systematic review of the original measurement items to ensure alignment with the professional context of early-career Generation Z accountants in Indonesia, while retaining the essential conceptual substance of each construct. Item inclusion was guided by conceptual relevance to the research framework and by their established application in prior empirical literature. Limited wording refinements were introduced to improve interpretive clarity and contextual appropriateness without modifying the constructs' theoretical foundations.

Although respondents' professional experience was relatively limited, the measurement of FDS in this study focused on foundational cognitive and analytical capabilities, including fraud awareness, anomaly recognition, and diagnostic judgment, rather than on advanced investigative or expert-level fraud examination skills. The proposed operationalization is well-suited to Generation Z accountants in the early phases of their professional careers and is consistent with the study's objective of examining how digital competence (DC) and data science literacy (DSL) influence the development of early fraud detection capabilities.

To address the risk of bias inherent in self-reported survey data, Harman's single-factor test was conducted as a diagnostic procedure. The analysis showed that the first unrotated factor accounted for less than half of the total explained variance, indicating that common method bias was unlikely to represent a serious concern. The primary data analysis was subsequently performed using PLS-SEM

through SmartPLS 3.0 software. This analytical approach was chosen for its capacity to estimate complex theoretical relationships and its suitability for studies involving moderate sample sizes compared with covariance-based SEM techniques (Hair et al, 2021). Nevertheless, given the well-documented limitations of Harman's test, future studies are encouraged to adopt more advanced techniques, such as marker variable methods or longitudinal research designs, to further mitigate potential common method variance (Hair et al, 2021).

Data analysis was conducted through a systematically structured three-stage process. The first stage focused on assessing the measurement model to confirm construct reliability and validity. The second stage evaluated the structural model to test the proposed causal linkages among variables. The third stage involved hypothesis testing to determine the statistical significance of the modeled relationships. Internal consistency reliability was deemed satisfactory when Cronbach's alpha and composite reliability values exceeded 0.70. Convergent validity was confirmed through Average Variance Extracted (AVE) values above 0.50, while discriminant validity was verified using both the Fornell–Larcker criterion and the Heterotrait–Monotrait (HTMT) ratio. Structural relationships were examined through path coefficients supported by bootstrapped t-statistics and p-values.

To enhance analytical rigor and replicability, the study implemented a two-stage PLS-SEM framework. The first stage assessed the measurement model, including indicator reliability, internal consistency, convergent validity, and discriminant validity. The second stage examined the structural model by analyzing path coefficients, explained variance (R^2), effect sizes (f^2), and predictive relevance (Q^2), with hypothesis testing conducted via bootstrapping.

Given the reliance on self-reported survey data, threats to internal validity—particularly self-report and common method bias could not be entirely ruled out. Mitigation strategies included preserving respondent anonymity, clarifying the absence of right or wrong answers, and designing questionnaire items to reduce evaluation apprehension. Harman's single-factor test was used diagnostically; however, it is acknowledged that this test alone cannot fully eliminate common method bias, and the findings should therefore be interpreted cautiously.

The research involved voluntary participation through questionnaire surveys and complied with institutional and national ethical standards for social science research in Indonesia. Participants were informed about the study's purpose and assured of confidentiality and anonymity. No identifiable personal information was collected, and respondents could withdraw at any time without consequence. Informed consent was implied through questionnaire submission. Due to the non-invasive design and anonymized data usage, formal ethical approval was not required under institutional policies.

RESULTS

This research focuses on how digital competence, data literacy, and diagnostic reasoning relate to the ability of Generation Z accountants in Indonesia to detect fraudulent practices. The study also seeks to capture current tendencies and influential factors shaping their analytical and professional development.

The participants consisted of 150 young accountants representing Generation Z, as shown in Table 1. Most of them were women, comprising about three-quarters of the total respondents (113 individuals), while men made up only a quarter (37 individuals). This pattern illustrates that women are increasingly active and visible in the accounting sector today.

Table 1. Demographic information of respondents

Characteristics	Measurement	Frequency	Percentage
Gender	Male	37	25%
	Female	113	75%
Age	21-23 Years	124	83%
	24-26 Years	26	17%
Level of Education	S1	98	65%
	S2/S3	12	8%
	Other	40	27%

Accounting Work Experience	<1 year	128	85%
	1-2 years	8	5%
	2-3 years	3	2%
	4-5 years	-	-
	>5 years	11	7%
Total	150		

A large proportion of the sample consisted of respondents aged 21–23, representing 83% (124 individuals) of the total sample, whereas the remaining 17% (26 individuals) were between 24 and 26 years old. This age profile reflects a group of early-career professionals who are just entering the accounting workforce.

In terms of academic qualifications, most participants held an undergraduate credential (65%, or 98 participants), while the remaining 35% (52 participants) had continued to postgraduate studies. From the perspective of professional experience, 85% of participants had worked for less than one year, while 15% had between one and two years of experience. This suggests that the sample mainly represents individuals who are still in the nascent phase of their professional journey in accounting.

Overall, this demographic information provides a clear picture of the respondents' backgrounds and mirrors the broader transition occurring within Indonesia's accounting community, where a new generation of digitally literate professionals is emerging.

To validate the measurement framework, this research employed confirmatory factor analysis combined with internal consistency testing across four latent dimensions: DC, DSL, DS, and FDS. Table 2 presents the summarized Cronbach's alpha coefficients for the observable indicators within each construct.

Table 2. Cronbach's alpha values for observable variables in each construct

Variable	Indicator	Loading Factor	Cronbach's Alpha	CR	AVE
Digital Competence (DC)			0.889	0.928	0.811
	Digital Skills	0.921			
	Problem Solving with Digital Devices	0.850			
	Adaptive Digital Transformation	0.928			
Data Science Literacy (DSL)			0.917	0.941	0.800
	Predictive Analysis	0.907			
	Big Data Processing	0.886			
	Communicating Data Insight	0.899			
	Summarizing Probabilities	0.887			
Diagnostic Skills (DS)			0.889	0.932	0.820
	Anomaly Detection	0.894			
	Data Interpretation	0.956			
	Analytical Thinking Skills	0.863			
Fraud Detection Skills (FDS)			0.752	0.858	0.668
	Use of Detection Tools	0.791			
	Behavioral Analysis	0.838			
	Response to Fraud	0.822			

All indicator items displayed factor loadings above 0.50, confirming that each variable appropriately reflects its corresponding construct. Reliability examination showed that Cronbach's alpha and composite reliability (CR) values for every latent variable exceeded 0.70, demonstrating strong internal consistency of the measurement scales.

In addition, the AVE values of all constructs exceeded the established threshold of 0.50, supporting the convergent validity of the construct measurement framework. These outcomes imply that the indicators not only represent the underlying concepts consistently but also maintain theoretical coherence. Further statistical verification revealed that all associations between constructs and their observed variables were highly significant, with p-values below 0.001.

Overall, this combination of validity and reliability assessments strengthens the robustness of the analytical model used to evaluate how effectively Generation Z accountants in Indonesia can identify fraudulent activities. The summarized measurement outcomes are reported in Table 3.

Table 3. CFA information and the reliability of information

Variable	Indicator	Std.loading (>0.5)	Cronbach's α	CR (>0.7)	AVE (>0.5)
Digital Competence (DC)			0.889	0.928	0.811
	Digital Skills	0.921			
	Problem Solving with Digital Devices	0.850			
	Adaptive Digital Transformation	0.928			
Data Science Literacy (DSL)			0.917	0.941	0.800
	Predictive Analysis	0.907			
	Big Data Processing	0.886			
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Discriminant validity was additionally assessed using the Heterotrait–Monotrait (HTMT) ratio, which is widely recognized as a more rigorous and sensitive approach for evaluating discriminant validity in variance-based structural equation modeling. Due to the conceptual closeness among digital competence, data science literacy, diagnostic skills, and fraud detection skills, several HTMT estimates were relatively high and approached the liberal cutoff value of 0.90. Such patterns are expected when constructs represent closely related but theoretically distinct professional capabilities.

To address concerns regarding potential construct redundancy, HTMT inference was conducted using a bootstrapping procedure to generate confidence intervals, in line with current best-practice recommendations (Hair et al, 2021). The bootstrapped confidence intervals for all HTMT estimates did not include the value of 1.00, indicating that discriminant validity was established despite the relatively high HTMT point estimates. This result suggests that the observed correlations reflect strong theoretical associations rather than problematic conceptual overlap.

Discriminant validity was further supported through the application of the Fornell–Larcker criterion, which verified that the square root of each construct's Average Variance Extracted (AVE) was greater than its correlations with other constructs. In addition, multicollinearity among latent variables was examined using the Variance Inflation Factor (VIF) statistics, with all values falling below the conservative cutoff of 5.0. Taken together, these findings confirmed that the constructs were empirically distinct and theoretically robust within the proposed structural model.

Overall, the convergent evidence confirmed that the measurement constructs were both empirically reliable and conceptually well differentiated. The robustness of the measurement structure strengthened confidence in the applicability of this framework for assessing fraud detection competence among Generation Z accounting practitioners in Indonesia. A detailed summary of these findings is provided in Table 4.

Table 4. Comparative validity metrics for constructs: HTMT and Fornell-Larcker criteria

Construct	DC	DSL	DS	FDS
Heterotrait-Moontrait Ratio of Correlation (HTMT)				
DC				
DSL	0.905			
DS	0.853	0.951		
FDS	0.831	0.900	0.896	
Formell-lacker Criterion				
DC	0.883			
DSL	0.807	0.900		
DS	0.771	0.887	0.947	
FDS	0.696	0.786	0.792	0.860

Beyond construct reliability and validity, additional PLS-SEM diagnostics were conducted to strengthen the robustness and replicability of the findings. At the indicator level, all outer loadings exceeded the recommended minimum threshold, confirming adequate item reliability. Multicollinearity assessment using the Variance Inflation Factor (VIF) indicated that all predictor constructs were below critical threshold values, suggesting no multicollinearity concerns. Model fit was evaluated using the Standardized Root Mean Square Residual (SRMR), which indicated an acceptable fit between the proposed model and the observed data. Furthermore, predictive relevance was assessed using the Stone–Geisser Q^2 statistic obtained through the blindfolding procedure, with positive Q^2 values confirming that the model had adequate predictive capability.

To ensure that the results were not distorted by potential bias arising from a single source of data collection, the study performed an assessment using Harman’s single-factor procedure. In this diagnostic step, all observed indicators were simultaneously entered into an exploratory factor analysis under a single latent factor. The cumulative variance accounted for by that single factor was found to be below the 50 percent threshold, implying that common-method variance was unlikely to threaten the integrity of the data. This outcome demonstrated that the responses collected from participants were not heavily influenced by a uniform response pattern, thereby reinforcing the overall robustness and trustworthiness of the dataset. Consequently, the measurement framework was considered both statistically valid and minimally affected by method bias.

Following this verification, the research proceeded to test the conceptual relationships specified in the hypotheses. The analytical focus was on how digital competence, data-driven literacy, and diagnostic reasoning collectively influenced the capacity to detect fraudulent practices. To achieve this, the study employed the PLS-SEM technique, which enabled simultaneous estimation of complex inter-construct relationships within a relatively small sample size. As illustrated in Figure 2, this modeling approach provided a nuanced understanding of the pathways linking technological skills, analytical literacy, and diagnostic capabilities to fraud detection proficiency. The PLS-SEM results, therefore, offered empirical insight into the behavioral and professional attributes shaping Generation Z accountants in Indonesia.

To strengthen the robustness of the PLS-SEM results, several supplementary diagnostic tests were performed before proceeding to structural model interpretation. Multicollinearity assessment using the VIF demonstrated that all inner model values were well below the 5.0 threshold, confirming the absence of serious collinearity among predictor constructs. Model fit was additionally evaluated using the Standardized Root Mean Square Residual (SRMR), which recorded a value below the recommended cut-off of 0.08, indicating an adequate correspondence between the hypothesized model and the empirical data. Furthermore, effect size (f^2) analysis revealed that digital competence and data science literacy contributed meaningfully to explaining diagnostic skills and fraud detection skills, highlighting the substantive importance of the structural relationships beyond statistical significance alone.

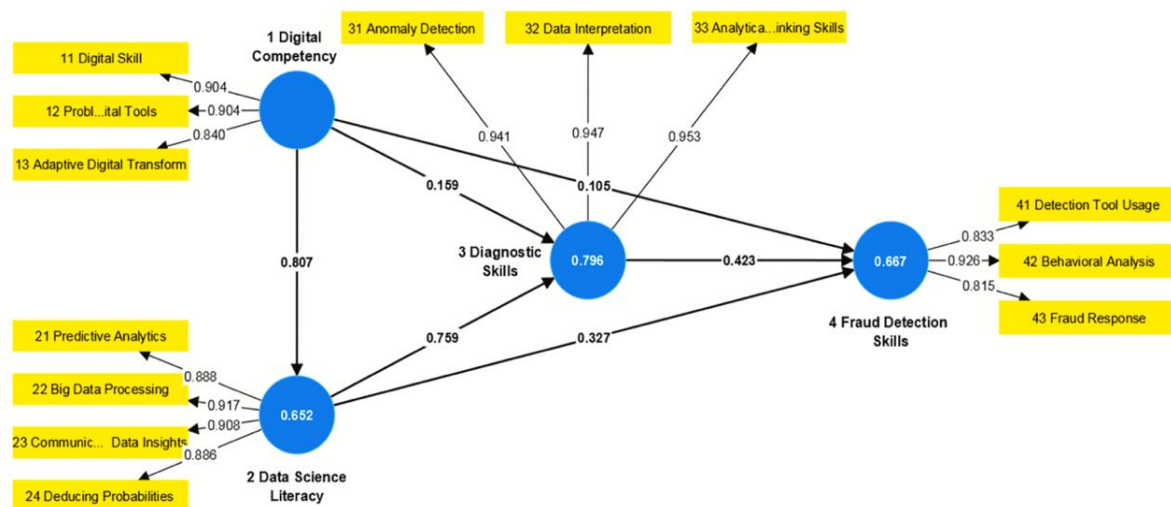


Figure 2. Structural Model

In addition to the coefficient of determination (R^2), the predictive relevance and effect size of the structural model were assessed. The predictive relevance (Q^2) values for Data Science Literacy, Diagnostic Skills, and Fraud Detection Skills were all above zero, indicating that the model possesses adequate predictive capability. Furthermore, effect size (f^2) analysis revealed that digital competence exerted a large effect on data science literacy, while data science literacy had a substantial effect on diagnostic skills. Diagnostic skills demonstrated a moderate-to-large effect on fraud detection skills, suggesting that the structural relationships are not only statistically significant but also practically meaningful.

This research explores how Generation Z accountants in Indonesia develop their ability to detect fraud through the integration of DC, DSL, DS, and FDS. The analysis reveals a robust and statistically significant linkage among these constructs. Digital Competence emerges as a primary driver of DSL, with a beta coefficient of 0.639 and a p-value of 0.000, highlighting a strong and consistent connection. In addition, DC exerts a meaningful, though comparatively smaller, influence on both DS and FDS, demonstrating that digital skills form an essential foundation for advanced analytical abilities.

Likewise, DSL has a decisive effect on DS and FDS, underscoring the indispensable role of data fluency in refining analytical reasoning and fraud detection accuracy. Diagnostic Skills also directly strengthen Fraud Detection Skills, with a beta coefficient of 0.397 and a p-value of 0.001, illustrating that critical thinking and analytical precision are central to uncovering irregularities.

Taken together, these results validate all proposed hypotheses and emphasize that digital and data proficiency are not merely technical advantages but essential cognitive enablers in modern accounting practice. The study thus offers an integrated perspective on how Generation Z accountants leverage technology-driven literacy to enhance their vigilance and effectiveness in fraud detection within Indonesia's evolving accounting landscape. A summary of these results is provided in Table 5.

Table 5. Overview of the results from the direct effect analysis

Hypothesis	Beta	Mean	SD	t-value	Bias corrected		p-value	Result
					Lower	Upper		
[H1] DC-DSL	0.639	0.641	0.048	13.342	0.530	0.722	0.000	Supported
[H2] DC-DS	0.681	0.684	0.066	3.550	0.102	0.357	0.000	Supported
[H3] DSL-DS	0.701	0.968	0.056	12.430	0.591	0.811	0.000	Supported
[H4] DC-FDS	0.691	0.697	0.076	2.849	0.075	0.361	0.004	Supported
[H5] DSL-FDS	0.599	0.593	0.097	3.299	0.146	0.515	0.001	Supported
[H6] DS-FDS	0.397	0.231	0.117	3.385	0.075	0.361	0.001	Supported

Meanwhile, the analysis of indirect effects and mediation pathways among DC, DSL, DS, and FDS reveals a complex network of relationships within the Generation Z accountant cohort in Indonesia. The results indicate that both DSL and DS act as pivotal mediators, bridging the influence of DC on FDS. Each indirect path is statistically significant, confirming the sequential mediating role of DSL, which first strengthens DS and, in turn, enhances FDS.

Furthermore, the findings highlight a notable chain mediation, in which DC indirectly enhances FDS through the sequential roles of DSL and DS. The credibility of these mediating effects is reinforced by high t-values and consistently low p-values across all tested pathways. This pattern suggests that digital and data literacy are not merely skill sets but function as cognitive bridges that translate technological competence into analytical depth and fraud detection precision.

Collectively, the path analysis underscores how Generation Z accountants leverage digital and data capabilities to refine diagnostic reasoning and, ultimately, strengthen their capacity to detect fraudulent behavior, as clearly demonstrated in Table 6.

Table 6. Summary of indirect/mediation analysis

Hypothesis	Beta	Mean	SD	t-value	Bias corrected		p-value	Result
					Lower	Upper		
DC-DS-DSL	0.451	0.451	0.053	8.502	0.346	0.553	0.000	Supported
DC-FDS-DSL	0.205	0.214	0.067	3.071	0.092	0.343	0.002	Supported
DC-FDS-DS	0.092	0.056	0.034	2.699	0.038	0.181	0.007	Supported
DSL-FDS-DS	0.278	0.259	0.085	3.279	0.120	0.443	0.001	Supported
DC-FDS-DSL-DS	0.178	0.166	0.055	3.222	0.080	0.294	0.001	Supported

These findings deepen insights into the structural and operational aspects of critical skills in the detection of fraud, while emphasizing the urgency of developing competencies in data science and digital technology to enhance the effectiveness of the identification and prevention of fraudulent activities within the accounting profession.

DISCUSSION

The findings indicate that digital competence does not have a direct effect on fraud detection skills among Generation Z accountants. This result suggests that technological familiarity alone is insufficient to enhance fraud-related judgment, particularly in complex, ill-structured, and judgment-intensive fraud detection tasks. While digital competence enables accountants to operate technological tools efficiently, it does not automatically provide the cognitive capacity required to interpret red flags, evaluate inconsistencies, or exercise professional skepticism in fraud contexts.

This finding is consistent with prior studies arguing that digital technologies improve audit and fraud detection outcomes only when supported by appropriate cognitive processing and judgment capabilities (Appelbaum et al., 2017; Cao et al., 2015). Prior research has shown that excessive reliance on technological tools without sufficient analytical reasoning may even create a false sense of assurance, thereby weakening fraud-related judgment. In this regard, digital competence should be viewed as an enabling condition rather than a sufficient determinant of fraud detection effectiveness.

Importantly, this result can be explained by the characteristics of early-career Generation Z accountants. Although this cohort exhibits high digital exposure and technological adaptability, their limited professional experience constrains their ability to contextualize digital outputs within complex fraud scenarios. In developing economies such as Indonesia, where the adoption of advanced audit technologies remains uneven and structured fraud training is limited, digital competence may primarily enhance task execution efficiency rather than judgment quality. Therefore, this study extends prior literature by identifying professional experience and contextual factors as boundary conditions that limit the direct impact of digital competence on fraud detection skills.

The results demonstrate a significant positive relationship between digital competence and data science literacy. This finding supports Social Learning Theory, which posits that individuals acquire advanced skills through observation, interaction, and repeated engagement with tools and professional practices. Digitally competent accountants are more capable of exploring analytical software, experimenting with data-driven approaches, and learning from digitally mediated work environments, thereby enhancing their data science literacy.

This finding aligns with prior research suggesting that digital proficiency facilitates the acquisition of data analytics and computational skills in accounting and auditing contexts (Richins et al., 2017; Sutton et al., 2018). Digital competence reduces cognitive barriers to learning complex analytical techniques, allowing individuals to focus on interpreting data rather than struggling with technological interfaces. For Generation Z accountants, who are accustomed to digital environments, digital competence functions as a foundational capability that accelerates the development of data-oriented skills essential for modern accounting tasks.

From a theoretical perspective, this result reinforces the role of Social Learning Theory in explaining how technological capabilities are developed through experiential learning. Continuous exposure to digital tools enables Generation Z accountants to internalize data science concepts, thereby transforming basic technological familiarity into more sophisticated analytical literacy. This finding highlights that digital competence is not an end capability but a prerequisite that facilitates higher-level skill acquisition.

Consistent with Information Processing Theory, the findings reveal that data science literacy significantly enhances diagnostic skills, which in turn strengthen fraud detection skills. Diagnostic skills represent a higher-order cognitive capability that allows accountants to analyze information, recognize meaningful patterns, and evaluate anomalies within a professional judgment framework. Data science literacy enhances an individual's capacity to process large volumes of financial and non-financial data, thereby improving the quality of diagnostic reasoning. This mediating role indicates that technological and analytical competencies must be cognitively transformed through reasoning processes to produce effective fraud detection outcomes. Similar conclusions have been reported in prior studies emphasizing the importance of analytical reasoning, professional skepticism, and judgment quality in fraud detection and audit decision-making (Brazel et al., 2009; Nelson, 2009). Without strong diagnostic skills, data analytics outputs remain descriptive rather than evaluative, limiting their usefulness in detecting fraud.

These findings provide empirical support for Information Processing Theory by demonstrating that fraud detection effectiveness depends on how information is encoded, interpreted, and integrated into judgment. Diagnostic skills function as the mechanism that converts analytical insights into actionable fraud-related decisions. This explains why data science literacy alone does not directly enhance fraud detection skills unless accompanied by strong diagnostic reasoning.

Taken together, these findings reinforce an integrative perspective in which fraud detection capability among Generation Z accountants emerges from the interaction between digital competence, data science literacy, and diagnostic reasoning. Digital competence facilitates learning and engagement with analytical tools (Social Learning Theory), while data science literacy and diagnostic skills enable effective information processing and judgment formation (Information Processing Theory). This integrated mechanism explains how technological capabilities are cognitively deployed rather than merely possessed.

By clarifying the indirect pathways through which digital competence influences fraud detection skills, this study contributes to the literature by shifting the focus from technological adoption to cognitive utilization. The findings also provide practical insights for accounting education and professional training, emphasizing that investments in digital technologies must be accompanied by deliberate efforts to develop diagnostic reasoning and judgment-oriented skills, particularly for early-career Generation Z accountants.

CONCLUSION

This study underscores the critical role of digital competence, data science literacy, and diagnostic acumen in strengthening fraud detection capabilities among Generation Z accounting practitioners in Indonesia. The results reveal that digital competence acts as a foundational enabler, enhancing data literacy, which subsequently sharpens diagnostic reasoning and elevates fraud detection performance. Grounded in Social Learning Theory, which emphasizes experiential knowledge acquisition, and Information Processing Theory, which focuses on how information is encoded and utilized, the findings highlight the need for an integrated skill set that merges technological fluency, analytical thinking, and adaptability to emerging digital tools. Such integration equips accountants to manage the intricate dynamics characterizing today's financial landscape, where digital transformation and ethical vigilance intersect.

The study's implications extend beyond theory, urging accounting firms, professional associations, and educators to embed these digital and analytical competencies within structured training and professional development programs. By aligning empirical insights with theoretical frameworks, this research offers a cohesive explanation of how digital literacy and data-driven expertise collectively reinforce accountants' ability to detect fraudulent behavior. Moreover, it advocates for the creation of more advanced, context-sensitive learning models and digital instruments tailored to the evolving demands of the accounting profession in the digital era.

While this study provides meaningful theoretical insights into the mechanisms through which digital competence and data science literacy enhance fraud detection, its findings are subject to important boundary conditions. The exclusive focus on early-career Generation Z accountants in Indonesia inherently limits the empirical generalizability of the results. The observed relationships reflect the characteristics of a digitally fluent yet professionally inexperienced cohort operating within a specific institutional context. As such, caution is warranted when extending these findings to more experienced accounting professionals or to jurisdictions with different regulatory, technological, and organizational environments.

This study is important because it introduces a fresh analytical lens on how technological proficiency and analytical data skills shape the effectiveness of Generation Z accounting practitioners in detecting fraud. The limitations identified here create significant opportunities for further, more in-depth research in areas that remain underexplored. Such research is expected to broaden understanding and foster innovation in tools and approaches for detecting and preventing fraud. By addressing these gaps, future studies have the potential to enhance theoretical insights and provide practical guidance for accounting professionals and regulatory stakeholders seeking to strengthen mechanisms for identifying fraudulent behavior within rapidly evolving technological environments. Taken as a whole, this study demonstrates that the effectiveness of fraud detection is largely driven by the development of diagnostic skills arising from digital competence and data science literacy. By explicating the cognitive pathways that translate digital and analytical capabilities into professional judgment, the study offers meaningful insights into the mechanisms underpinning fraud detection expertise. These findings provide actionable guidance for accounting education, professional training, and organizational policy aimed at strengthening fraud detection practices in increasingly digitalized accounting environments.

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