Research Article

Statistical Literacy in Internal Auditing: Cognitive And Affective Dimensions

İç Denetimde İstatistiksel Okuryazarlık: Bilişsel ve Duyuşsal Boyutu

Esra SATICI

Dr. Öğr. Üyesi, Ankara Sosyal Bilimler Üniversitesi

Denetim ve Risk Yönetimi Anabilim Dalı

esra.satici@gmail.com

https://orcid.org/0000-0002-6784-182X

Abstract

In today's digital age, characterized by the growing volume of data and the need for making accurate, data-driven decisions, statistical literacy has become a fundamental skill in the internal auditing. The literature examines the level of statistical literacy in two dimensions. The first dimension involves cognitive factors, which encompass understanding and interpreting information, while the second dimension pertains to affective factors, including emotions related to the subject, This study aims to examine the levels of statistical literacy of public internal auditors in both dimensions and to determine their knowledge and self-efficacy levels. An online survey, designed with scales aligned to the study's purpose, was used as the data collection tool. The study was evaluated based on the results of 109 participants who provided valid responses to the survey.

The internal auditors participating in the study considered themselves moderately self-efficacy in statistical data literacy. Demographic differences such as education level and years of service had no impact on this result. When the statistical literacy knowledge levels of internal auditors were assessed, it was observed that their interpretation and critical interpretation skills were strong. According to the results, 61% of the participating internal auditors were classified as statistically literate. Some demographic differences were found to have an effect on this result.

Public internal auditors are evaluated as successful in terms of statistical data literacy, yet they do not exhibit the same level of confidence in themselves. Enhancing confidence through the support of knowledge can facilitate the development of this aspect. Consequently, statistical data literacy can be utilized more actively in internal auditing.

Key Words: Statistical literacy, cognitive dimension, self-efficacy, internal audit, GAISE

Öz

Günümüz dijital çağında, artan veri hacmi ve doğru, veri odaklı karar alma gerekliliği ile birlikte, istatistiksel okuryazarlık iç denetim alanında temel bir yetkinlik haline gelmiştir. Literatürde istatistiksel okuryazarlık düzeyi iki boyutta incelenmektedir. Birinci boyut, bilgiyi anlama ve yorumlama gibi bilişsel faktörleri içerirken, ikinci boyut, konuya ilişkin duyguları içeren duyuşsal faktörlerle ilgilidir. Bu çalışma, kamu iç denetçilerinin istatistiksel okuryazarlık düzeylerini her iki boyutta da incelemeyi ve bilgi ile öz yeterlilik düzeylerini belirlemeyi amaçlamaktadır. Çalışmanın amacına uygun ölçeklerle hazırlanmış çevrim içi anket veri toplama aracı olarak kullanılmıştır. Çalışma, anketi geçerli olan 109 katılımcının sonuçlarına göre değerlendirilmiştir.

Çalışmaya katılan iç denetçiler, kendilerini istatistiksel veri okuryazarlığı konusunda orta düzeyde öz yeterli olarak değerlendirmiştir. Eğitim düzeyi ve hizmet süresi gibi demografik farklılıkların bu sonuca etkisi olmadığı gözlemlenmiştir. İç denetçilerin istatistiksel okuryazarlık bilgi düzeyleri değerlendirildiğinde, yorumlama ve eleştirel yorumlama becerilerinin

güçlü olduğu görülmüştür. Sonuçlara göre, ankete katılan iç denetçilerin %61'i istatistiksel okuryazar olarak sınıflandırılmıştır. Bazı demografik farklılıkların bu sonuca etkisinin olduğu tespit edilmiştir.

Kamu iç denetçileri, istatistiksel veri okuryazarlığı açısından başarılı olarak değerlendirilmekle birlikte, kendilerine bu konuda duydukları güven düzeyleri aynı seviyede değildir. Bilginin desteklenmesi ile bu konuda güvenin artırılması sağlanabilir. Bu sayede, istatistiksel veri okuryazarlığı iç denetimde daha aktif kullanılabilir.

Anahtar Kelimeler: *İstatistiksel okuryazarlık, bilişsel boyut, öz yeterlik, iç denetim, GAISE*

1. Introduction

In today's digital world, making data-driven decisions and interpreting statistical information have become crucial. Complex issues in areas such as health, economy, environment, and education require understanding and applying statistical knowledge. In this context, statistical literacy enables better analysis and resolution of problems.

Statistical literacy is a multifaceted competency that involves the ability to comprehend, interpret, assess, and communicate statistical information. It encompasses understanding statistical data and arguments, familiarity with statistical concepts, terminology, and symbols, critical evaluation of statistical claims, and the ability to present the outcomes of statistical analyses (Masfingatin & Suprapto, 2020). This skill is crucial for individuals to analyze and assess statistical information, construct data-driven arguments, and make informed decisions. Additionally, statistical literacy incorporates aspects of data literacy, such as understanding data collection processes, addressing concerns related to data privacy and ownership, creating basic descriptive data tools, and acknowledging the significance of data provenance (Umbach, 2022).

Statistical literacy highlights the importance of viewing probability as a measure of uncertainty. The internal auditing also inherently focused on identifying risks, requires competencies that address uncertainties and interpret probabilities while considering possible outcomes in their processes. Internal auditors contribute to organizations by effectively managing risks using complex risk modeling, statistical sampling, and computer-assisted audit techniques (Abuazza et al., 2015). Effective auditing is expected in sustainable corporate governance processes. Given the rapid digitalization, transformations and updates in auditing competencies have become inevitable to maintain validity (Köse & Polat, 2021). Identifying the current state and competencies, addressing areas for improvement, and taking progressive steps accordingly are essential for meeting this need.

Statistical literacy can be considered alongside data analytics as part of the performance competencies required for fulfilling internal auditing duties in compliance with standards. It is also among the essential skills needed to identify and address sector-specific risks and challenges faced by organizations. Objectivity, a core principle in internal audit standards, ensures that internal audit activities are conducted independently and impartially. Data-driven decision-making, evaluating findings through statistical analyses, and eliminating subjectivity in the audit process contribute to achieving defensible audit results, thereby supporting good governance principles. In this sense, statistical literacy is not merely a technical competency for internal auditors but also a strategic tool.

Developing statistical literacy is also crucial for promoting a data-driven decision-making culture within organizations. As highlighted by Takaria et al. (2020), statistical literacy involves the ability to extract meaningful insights from data and engage critically with statistical information. This ability enables auditors to derive valuable information from complex datasets and provide actionable recommendations. The capability to evaluate statistical information as evidence makes statistical data literacy highly significant in internal audit. In addition to cognitive competence, self-efficacy—an individual's confidence in their abilities—is a key factor influencing this skill. Self-efficacy also contributes to overcoming cognitive challenges (Sevimli & Aydın, 2017). Furthermore, Ford (1992) emphasized the impact of beliefs on behavior in his study.

This study evaluates internal auditors' levels of statistical data literacy, identifies demographic factors influencing these evaluations, and examines the confidence levels of internal auditors in their statistical literacy and the effect of this confidence on cognitive assessment.

2. Statistical Literacy and Self-Efficacy

Statistical literacy involves making data-driven inferences, adopting a critical perspective, understanding the language of statistics, and evaluating and interpreting data in various contexts. (Özmen & Baki, 2017). Additionally, statistical literacy encompasses the ability to assess statistical information as evidence, interpret summary statistics and graphs, and identify the potential misuse of statistics, including the way figures are

presented. This comprehensive skill set enables individuals to effectively utilize statistical information and make sound, data-driven decisions.

Statistical literacy is not limited to reading statistical information presented, but also includes imagining unreported data and the assumptions underlying this information (Büscher, 2022). This aspect is regarded as interpreting information and can be considered decision-making based on knowledge. It involves interpreting statistical data, using statistics as evidence in arguments, and effectively presenting statistical information. Statistical literacy considers three cognitive competencies: knowledge, interpretation, and critical interpretation (Şahin, 2012). It also encompasses elements such as understanding fundamental statistical concepts, statistical competence, and statistical citizenship (Hahs-Vaughn et al., 2017). The evolving nature of statistical literacy has become evident in response to the increasing volume and complexity of data in contemporary digital society. During this data-intensive era, individuals must possess the ability to evaluate concepts related to statistics and probability to interpret situations accurately (Gal, 2002).

In conclusion, statistical literacy is a fundamental skill that enables individuals to navigate the vast world of data, interpret statistical information accurately, and make evidence-based, informed decisions. It encompasses a range of competencies that emphasize interpreting data, critically evaluating statistical information, understanding statistical concepts, and effectively communicating findings. As data continues to play a central role, the significance of statistical literacy cannot be overlooked. Considering that every individual is the strategist of their own life, it is not an exaggeration to assert that statistical literacy is a civic duty to avoid misconceptions and biased decisions. As emphasized by Ridgway et al. (2011), in today's information age, statistical literacy has become a basic life skill for every citizen. A statistically literate person is expected to understand fundamental statistical concepts, terms, and symbols, as well as some basic probabilities, and critically evaluate statistical information encountered in daily life.

In solving mathematical problems, it is believed that affective factors should be considered alongside cognitive factors (Kıral Demir & Katrancı, 2023). One of these affective factors is the self-efficacy. Pajares and Miller (1994) examined the mediating role of self-efficacy beliefs in mathematical problem-solving and demonstrated a significant mediating effect. Based on this, it can be said that self-efficacy plays a critical role in strengthening individuals' beliefs in their ability to solve mathematical and statistical problems, thereby enhancing learning and achievement.

Statistical literacy self-efficacy refers to an individual's confidence in their ability to comprehend, analyze, interpret, and apply statistical information. Grounded in Bandura's social cognitive theory, the concept of self-efficacy reflects a person's perception of their capability to successfully perform a particular task (Bandura, 1982). In a statistical context, this concept reflects an individual's confidence in their ability to successfully perform tasks related to statistics. The literature on self-efficacy provides various definitions (Pajares, 1996; Ford, 1992), and it is ultimately defined as confidence in one's abilities. Sevimli and Aydın (2017) emphasized in their study that domain-specific self-efficacy assessments would be effective in measurement and evaluation. This implies that success in a field like statistics can be influenced by self-efficacy within that field. Therefore, evaluations should consider domain-specific self-efficacy levels in statistics rather than general personal confidence.

3. Method

3.1. Data Collecting

This study aims to reveal the statistical literacy levels of public internal auditors in terms of cognitive and affective dimensions, adopting a survey model. To perform this assessment, two separate scales were utilized. For measuring statistical literacy, the scale developed by Şahin (2012), aligned with the Guidelines for Assessment and Instruction in Statistics Education (GAISE, 2016), was employed. The GAISE guide serves as a recommendation framework prepared by a committee of the American Statistical Association to improve statistics education in universities. In Şahin's (2012) study, the syllabi of statistics courses offered in faculties of Economics and Administrative Sciences, Engineering, and Sciences were analyzed to determine common topics, and scale items were developed based on the fundamental understanding of statistical proficiency.

For the affective dimension of the study, the Statistical Literacy Self-Efficacy Scale presented by Batur et al. (2019) was utilized to assess confidence in statistical data literacy. This scale was designed in a 5-point Likert format and validated in accordance with the components of "statistical process", "reasoning" and "knowledge of basic concepts" in Özmen's (2015) statistical literacy model. Items representing the dimensions of statistical literacy emphasized in this study were selected and included in the research.

The questionnaire, structured within the framework of the internal auditing profession, consists of 14 questions in the statistical self-efficacy section and 11 questions (18 questions including subcategories) in the literacy section, allowing for cognitive assessment. Additionally, seven questions were included to interpret demographic differences.

The survey form, approved by the Ethics Committee of Ankara Social Sciences University, was transferred to Google Forms and distributed to the email addresses of public internal auditors with the support of professional organizations. Data collection continued throughout July 2024. The study was evaluated based on the responses of 109 participants whose surveys were valid. However, the forms submitted by two participants who were graduates of Law and Health Sciences faculties were excluded, as the statistical literacy scale used in the study was developed based on the programs of Science, Economics and Administrative Sciences (EAS), and Engineering faculties. The reverse-coded items included in the self-efficacy scale were reverse-scored and incorporated into the analysis.

3.2. Findings

The research findings were addressed in two main sections: statistical literacy levels and statistical literacy self-efficacy levels. The results were evaluated separately across demographic characteristics and tested using statistical analyses appropriate to the data structure.

Demographics

Firstly, the responses provided by internal auditors in the demographic section of the survey were examined. It was observed that the average age of the participants was 47, with an age range between 33 and 64 years. Correspondingly, the majority of the internal auditors had 10 years or less of professional experience (22% with 5 years or less), 18% had 11–15 years, and 30% had more than 15 years of experience in the field. The most commonly audited area was compliance audits (51%), followed by system audits (38%). The combined proportion of those conducting financial and IT audits was 11%.

An analysis of the educational background of the internal auditors participating in the survey revealed that the majority (61%) were graduates of the Faculty of Economics and Administrative Sciences (EAS), 37% were graduates of the Faculty of Engineering, and 2% were graduates of the Faculty of Arts and Science. Additionally, 54% of the participants held a master's degree, while 14% had a doctoral degree.

Statistical Data Literacy Belief - Self-Efficacy

The reliability of the self-efficacy scale administered to the participant group was evaluated using Cronbach's Alpha, yielding a value of 0.952, which signifies a high level of reliability in the data structure. The statistical appropriateness of the scale items was determined through the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity, as shown in Table 1.

Table 1. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure		,913
Bartlett's Test of Sphericity	Approx. Chi-Square	2040,016
	df	231
	Sig.	,000

Since KMO = 0.913 > 0.80, the sample size is adequate for scale evaluation, and the significance of Bartlett's test (p = 0.000 < 0.05) indicates that the data is suitable for factor analysis.
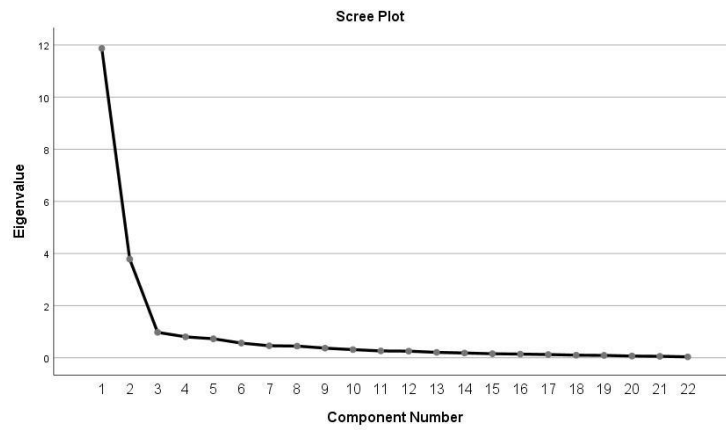
Figure 1. Scree Plot Graph

The scree plot presented in Figure 1 for the scale items, when evaluated together with the variance explained ratios (Appendix 1), shows that the scale items can be represented by two factors. These two factors explain approximately 71% of the total variance. The statistical literacy self-efficacy scores of the internal auditors who participated in the survey were calculated by considering the factor loadings of these factors, and analyses were conducted based on these scores. The factor loadings are provided in Table 2.

Table 2. Factor Loading Values

	Component			Component	
	1	**2**		**1**	**2**
Q1		0,786	Q12	0,86	
Q2		0,846	Q13	0,87	
Q3		0,874	Q14	0,832	
Q4		0,898	Q15	0,747	
Q5		0,721	Q16	0,882	
Q6		0,626	Q17	0,753	
Q7	0,847		Q18	0,887	
Q8	0,877		Q19	0,89	
Q9	0,902		Q20	0,91	
Q10	0,864		Q21	0,775	
Q11	0,88		Q22	0,795	

When the factor loadings were examined, a clear separation into two factors was observed. Accordingly, the calculated self-efficacy scores were transformed to a 0-100 scale using interpolation for ease of interpretation. Upon examining the scores, it was found that the internal auditors who participated in the survey had an average level of self-efficacy in their statistical literacy (mean self-efficacy scale score = 65.833). After performing assumptions, when the statistical literacy self-efficacy scores of internal auditors were compared based on gender, education level, undergraduate field, years of experience in the profession, and areas of internal audit activity, no statistically significant differences were found between these groups regarding their self-efficacy in statistical data literacy. In other words, regardless of their education level, undergraduate field, years of professional experience, or the area of audit in which they are most active, internal auditors exhibited the same level of self-efficacy in their statistical data literacy, with this confidence level being close to the average self-efficacy level of 65.

Statistical Literacy Level

The statistical literacy level of public internal auditors who participated in the survey was measured using a total of 18 questions, which included knowledge, interpretation, and critical interpretation questions addressed in Şahin's (2012) study. The evaluation was based on the number of correct answers, assuming that each question and phase held equal value.

The average number of correct answers among internal auditors was approximately 9 out of 18. In Şahin's (2012) study, which forms the basis of this research, most questions focused on interpreting statistical data and establishing a connection between statistical information and the provided interpretation. Additionally, in this study, questions were added in the "knowledge" section to assess internal auditors' understanding of visual representation tools. Fifty percent of participants answered two out of three questions in this section correctly, while 8% answered all correctly (Appendix 2).

In the interpretation section, three questions related to sampling, probability, and distribution knowledge were asked. Ninety percent of internal auditors answered two or more of these questions correctly, while 10% answered only one or none correctly (Appendix 3). The critical interpretation section consisted of questions related to interpreting provided information and establishing context. A total of 12 questions were included in this section, focusing on interpreting descriptive statistics, handling outliers, conditional probability interpretation, and cause-effect relationships. An evaluation of the responses revealed that 65% of participants answered more than half of these questions (more than 6) correctly. However, 9% of participants answered only one, two, or three questions correctly (Appendix 4).

As stated earlier, statistical literacy questions were categorized and analyzed based on the ability to understand the provided information, interpret statistical data, and establish a statistical context based on the given interpretation. A statistically literate individual is expected to succeed in all three areas (Şahin, 2012). In this study, knowledge was evaluated using visual representation questions, which were assessed as part of general statistical knowledge interpretation. From this perspective, a statistically literate internal auditor is expected to be successful in the interpretation and critical interpretation areas. Internal auditors who correctly answered more than half of the questions in the respective sections were deemed successful and defined as statistically literate. Accordingly, the proportion of statistically literate internal auditors was found to be 61%.

When the distribution of statistically literate internal auditors across demographic characteristics was examined, it was observed that 77% were male, 23% were female, 53% were graduates of the Faculty of Economics and Administrative Sciences (EAS), and 47% were graduates of the Faculty of Engineering. Regarding years of professional experience, 23% had 5 years or less, 40% had 6–10 years, 11% had 11–15 years, and 26% had more than 15 years of experience. Regarding the primary areas of audit activity, 51% were involved in compliance audits, 5% in financial audits, 11% in IT audits, and 34% in system audits. The distribution of statistically literate internal auditors by demographic characteristics is detailed in Appendix 5.

The effect of these demographic characteristics on statistical literacy was investigated using the Chi-Square Independence Test. Detailed results are presented in Table 3.

Table 3. Chi-Square Test of Independence Results

	Chi-Square	**df**	**Significance**
Gender	,016[a]	1	0,899
Education Level	1,190[a]	2	0,552
Audit Area	,531[a]	1	0,466
Undergraduate Field	5,331[a]	1	0,021
Experience in the Profession	11,005[a]	3	0,012

According to Table 3, it is seen that gender, education level and the field in which most auditing activities are carried out do not have an effect on the literacy level of internal auditors, and literacy status is independent of these variables (p>0.05). In addition, it can be said with 95% reliability that the field of undergraduate graduation and the experience in the profession have an effect on the literacy levels of internal auditors, and that they affect the literacy status (p<0.05). When the detailed distributions of these effective variables are

examined, 53% of the internal auditors who graduated from the Faculty of Economics and Administrative Sciences are statistically literate, while 76% of the internal auditors who graduated from the Faculty of Engineering are statistically literate. However, when examined in terms of professional experience, it is observed that 40% of the literate internal auditors had 6-10 years of experience in the internal audit. This rate is followed by 26% of internal auditors with more than 15 years of experience, 23% with less than 5 years of experience, and 11% with 11-15 years of experience. Based on this, it can be said that the majority of statistically literate internal auditors (63%) have less than 10 years of experience.

In order to evaluate the effect of internal auditors' self-confidence on literate status, statistical data literacy self-efficacy averages were also compared for statistical literate and non-statistical literate internal auditors. When the self-efficacy scores of internal auditors who answered all the questions were evaluated in terms of whether they were statistically literate or not, the results given in Table 4 were reached.

Table 4. Comparison Test Results of the Average Self Efficacy Scale Based on Statistical Literacy Status

		N	Mean	Std. Dev.	Levene's Test (Equality of Variances)		t-test	
					F	Sig	t	p(sig.)
Self Efficacy Scores	**Non-Statistical Literate**	37	65.356	19.344	0.173	0.678	-0.195	0.846
	Statistical Literate	49	66.194	20.056				

According to Table 4, the self-efficacy scale score of statistical literate internal auditors were found to be 66.194, while the non-statistical literate internal auditors were found to be 65.356. It can be said with 95% confidence that this difference is not statistically significant, that statistically literate and non-statistically literate internal auditors have the same self-confidence in this regard, in other words, that their average self-efficacy scores are similar ($p > 0.05$).

4. Results and Recommendations

The increasing volume of data and information complicates their straightforward analysis, interpretation, and reporting. This necessitates internal auditors across all sectors to go beyond traditional methods and enhance their statistical literacy skills. The success of future auditing practices will depend on the auditors' ability to improve their competencies in statistical literacy and data analytics (Appelbaum et al., 2021). Based on this premise, this study focuses on examining the current statistical literacy levels of public internal auditors in our country, their confidence levels regarding statistical data literacy, and the factors influencing their statistical literacy and confidence levels.

Within this scope, validated scales were utilized; the scale by Şahin (2012) for the cognitive dimension of statistical literacy and the scale by Batur et al. (2019) for the affective dimension. The evaluation revealed some deficiencies in visual representation in terms of general knowledge. It was observed that 50% of the participants internal auditors could correctly answer more than half of the graphical representation questions. Providing information on this topic could potentially enhance the auditors' efficiency in practice. Furthermore, it was noted that internal auditors were more successful in transforming information into interpretation and establishing context. Sixty-five percent of the internal auditors succeeded in critical interpretation questions.

In the self-efficacy assessment, internal auditors were found to have a moderate level of confidence in their statistical literacy skills, and this confidence was independent of their education level, undergraduate field of study, years of experience, and primary area of auditing activity. In this study, internal auditors who answered more than half of the interpretation questions correctly were defined as statistically literate. Accordingly, 61% of the internal auditors participating in the survey were identified as statistically literate. Statistical analyses showed that this literacy was independent of gender, education level, and the area of auditing but was related to the undergraduate field of study and years of professional experience.

Internal auditors with an engineering background and less than 10 years of experience had higher literacy rates. However, as mentioned above, self-efficacy in statistical literacy did not vary across these groups and remained at a moderate level. Contrary to expectations, the statistical literacy performance of internal auditors was not associated with their confidence in this area. Similar findings in the literature have also highlighted the absence of a significant relationship between self-efficacy and performance (Bandalos, Yates, & Therndike-Christ, 1995; Schneider, 2011). It is anticipated that supporting knowledge in this area, increasing awareness of statistical literacy, and reducing statistical anxiety could improve confidence and the effective use of statistical data in professional work life. Future studies focusing on the awareness and anxiety levels related to statistical literacy are expected to provide valuable insights.

This study is notable as the first research focusing on statistical literacy in the field of internal auditing. It also highlights areas requiring further academic investigation. For instance, the GAISE (2016) guidelines emphasize not only the understanding and interpretation of core concepts but also the use of technological tools and ethical responsibility. This study did not specifically evaluate the extent to which internal auditors effectively utilize technology in data analysis or their adherence to ethical principles and reliability in using data. Furthermore, the professional needs related to statistical literacy in internal auditing were assessed through observational evaluations, and no detailed qualitative study was conducted. Future detailed studies in these areas will help enhance and strengthen this research.

References

Abuazza, W. O., Mihret, D. G., James, K. & Best, P. (2015). The perceived scope of internal audit function in Libyan public enterprises. *Managerial auditing journal*. Vol. 30 No. 6/7, 2015 pp. 560-581.

Appelbaum, D., Showalter, D., Sun, T., & Vasarhelyi, M. (2021). A Framework for Auditor Data Literacy: A Normative Position. *Accounting horizons*. 35 (2):5-25. https://doi.org/10.2308/HORIZONS-19-127.

Bandalos, D. L., Yates, K. & Thorndike-Christ, T. (1995). Effects of Math Self-Concept, Perceived Self-Efficacy, Andattributions For Failure And Success On Test Anxiety. *Journal of Educational Psychology*, 87(4), 611-623.

Bandura, A. (1982). Self-Efficacy Mechanism in Human Agency. *American psychologist*. 37. 122-147.

Batur, A., Yiğit, N., & Baki, A. (2019, Nisan 12-14). *İstatistiksel okuryazarlık öz yeterlilik ölçek geliştirme çalışması*. Uluslararası Fen, Matematik, Girişimcilik ve Teknoloji Eğitimi Kongresi. İzmir, Türkiye.

Büscher, C. (2022). Design principles for developing statistical literacy in middle schools. *Statistics Education Research Journal*, 21(1), Article 8. https://doi.org/10.52041/serj.v21i1.80

Ford ME. (1992). Human Motivation: Goals, Emotions and Personal Agency Beliefs, Newbury Park, CA: Sage.

GAISE (2016). *GAISE College Report ASA Revision Committee, "Guidelines for Assessment and Instruction in Statistics Education College Report 2016,"* http://www.amstat.org/education/gaise.

Gal, I. (2002). Adults' statistical literacy: Meanings, components, responsibilities. *International Statistical Review*, 70(1), 1–25. https://doi.org/10.2307/1403713.

Hahs-Vaughn, D. L., Acquaye, H., Griffith, M. D., Jo, H., Matthews, K., & Acharya, P. (2017). Statistical literacy as a function of online versus hybrid course delivery format for an introductory graduate statistics course. *Journal of Statistics Education*, 25(3), 112–121. https://doi.org/10.1080/10691898.2017.1370363.

Kıral-Demir, B., & Katrancı, Y. (2023). Problem çözmeye yönelik öz-yeterlik ölçeği geliştirme çalışması. *Kocaeli Üniversitesi Eğitim Dergisi*, 6(2), 374-394. http://doi.org/10.33400/kuje.1221777.

Köse, H. Ö. & Polat, N. (2021). Dijital dönüşüm ve denetimin geleceğine etkisi. *Sayıştay Dergisi*, 32(123): 9-41 https://doi.org/10.52836/sayistay.1068328.

Masfingatin, T., & Suprapto, E. (2020). Student's statistical literacy skills based on the reflective and impulsive cognitive styles. *Al-Jabar: Jurnal Pendidikan Matematika*, 11(2), 273–286. https://doi.org/10.24042/ajpm.v11i2.6902

Özmen, Z. (2015). *Farklı Lisans Programlarında Okuyan Öğrencilerin İstatistik Okuryazarlığının İncelenmesi*. [Doktora Tezi, Karadeniz Teknik Üniversitesi]. YÖK Tez Merkezi.

Özmen, Z., & Baki, A. (2017). Farklı programlarda istatistik dersi veren öğretim elemanlarının uygulamalarının istatistik okuryazarlığı bağlamında değerlendirilmesi. *Eğitim ve Bilim*, 42(191), 323-349.

Pajares, F., & Miller, M. D. (1994). Role of self-sfficacy and self-concept beliefs in mathematical problem solving: a path analysis. *Journal of Educational Psychology*, 86(2), 193–203. https://doi.org/10.1037/0022-0663.86.2.193

Pajares, F. (1996). Self-efficacy beliefs and mathematical problem-solving in gifted students. *Contemporary Educational Psychology,* 21, 325-344.

Ridgway, J., Nicholson, J., & McCusker, S. (2011). Developing statistical literacy in students and teachers. In C. Batanera, G. Burrill, ve C. Reading (Edt.), *Teaching statistics in school mathematics-challenges for teaching and teacher education: a joint ICMI/IASE study: The 18th ICMI Study* (311-322). (18th ICMI Study). Springer Verlag.

Schneider, W.R. (2011). *The relationship between statistics self-efficacy, statistics anxiety, and performance in an introductory graduate statistics course*, [Doktora Tezi, Department of Adult, Career, and Higher Education College of Education University of South Florida]. https://digitalcommons.usf.edu/etd/3335/.

Sevimli, N. E., & Aydın, E. (2017). İstatistik Öz Yeterlilik inanç ölçeğinin Türkiye örneklemine uyarlanması. *Eğitim ve insani bilimler dergisi: teori ve uygulama*, 8(16), 44-57.

Şahin, F. (2012). A Study For Development Of Statıstıcal Lıteracy Scale For Undergraduate Students. [Yüksek Lisans Tezi, Boğaziçi Üniversitesi]. YÖK Tez Merkezi.

Takaria, J., Wahyudin, W., Sabandar, J., & Dahlan, J. A. (2020). Relationship between statistical literacy and mathematical representation of students through collaborative problem solving model. *Infinity*, 9(2), 183-196.

Umbach G. (2022). Statistical and data literacy in policy-making. *Statistical Journal of the IAOS*. 38(2):445-452. doi:10.3233/SJI-220962.

Appendix 1: Total Variance Explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11,871	53,958	53,958	11,622	52,826	52,826
2	3,787	17,211	71,170	4,036	18,343	71,170
3	,976	4,435	75,604			
4	,804	3,652	79,257			
5	,729	3,311	82,568			
6	,564	2,564	85,133			
7	,462	2,100	87,232			
8	,447	2,033	89,265			
9	,369	1,679	90,944			
10	,314	1,426	92,370			
11	,262	1,191	93,561			
12	,253	1,151	94,712			
13	,208	,946	95,658			
14	,183	,830	96,488			
15	,156	,708	97,196			
16	,141	,641	97,838			
17	,125	,568	98,405			
18	,100	,454	98,859			
19	,093	,421	99,280			
20	,067	,303	99,583			
21	,057	,257	99,840			
22	,035	,160	100,000			

Extraction Method: Principal Component Analysis.

Appendix 2: Accuracy Rates of Visual Description Questions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	37	34,6	41,1	41,1
	2,00	45	42,1	50,0	91,1
	3,00	8	7,5	8,9	100,0
	Total	90	84,1	100,0	
Missing	System	17	15,9		
Total		107	100,0		

Appendix 3: Accuracy Rates of Interpretation Questions

Total Number of Correct Answers		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	,00	1	,9	,9	,9
	1,00	10	9,3	9,4	10,4
	2,00	43	40,2	40,6	50,9
	3,00	52	48,6	49,1	100,0
	Total	106	99,1	100,0	
Missing	System	1	,9		
Total		107	100,0		

Appendix 4: Accuracy Rates of Critical Interpretation Questions

Total Number of Correct Answers		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	,00	2	1,9	1,9	1,9
	1,00	2	1,9	1,9	3,8
	2,00	1	,9	,9	4,7
	3,00	5	4,7	4,7	9,4
	4,00	4	3,7	3,8	13,2
	5,00	23	21,5	21,7	34,9
	6,00	23	21,5	21,7	56,6
	7,00	26	24,3	24,5	81,1
	8,00	14	13,1	13,2	94,3
	9,00	3	2,8	2,8	97,2
	10,00	3	2,8	2,8	100,0
	Total	106	99,1	100,0	
Missing	System	1	,9		
Total		107	100,0		

Appendix 4: Distribution of Literate Internal Auditors

S1. Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	15	23,1	23,1	23,1
	Male	50	76,9	76,9	100,0
	Total	65	100,0	100,0	

S3. Educational degree

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor's Degree	22	33,8	33,8	33,8
	Masters Degree	33	50,8	50,8	84,6
	PhD	10	15,4	15,4	100,0
	Total	65	100,0	100,0	

S4. Field of undergraduate graduation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	EAS	33	50,8	53,2	53,2
	Engineering	29	44,6	46,8	100,0
	Total	62	95,4	100,0	
Missing	System	3	4,6		
Total		65	100,0		

S7. Length of professional experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	2	3,1	3,1	3,1
	1-5 Years	13	20,0	20,0	23,1
	6-10 Years	26	40,0	40,0	63,1
	11-15 Years	7	10,8	10,8	73,8
	More than 15 Years	17	26,2	26,2	100,0
	Total	65	100,0	100,0	

S10. The area with the most audit activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Compliance	33	50,8	50,8	50,8
	Financial	3	4,6	4,6	55,4
	IT	7	10,8	10,8	66,2
	System	22	33,8	33,8	100,0
	Total	65	100,0	100,0	

Statistical Literacy in Internal Auditing: Cognitive And Affective Dimensions

İç Denetimde İstatistiksel Okuryazarlık: Bilişsel ve Duyuşsal Boyutu

Esra SATICI

Dr. Öğr. Üyesi, Ankara Sosyal Bilimler Üniversitesi

Denetim ve Risk Yönetimi Anabilim Dalı

esra.satici@gmail.com

https://orcid.org/0000-0002-6784-182X

Genişletilmiş Özet

Bu çalışma, kamu iç denetçilerinin istatistiksel okuryazarlık düzeylerini bilişsel ve duyuşsal boyutlarıyla incelemeyi amaçlamaktadır. Dijital çağın veriye dayalı karar alma ihtiyacı, iç denetimde istatistiksel okuryazarlığı temel bir yetkinlik haline getirmektedir. . Veriye dayalı karar verme, istatistiksel analizler ile bulguları değerlendirme, denetim sürecinde öznelliği kaldırarak savunulabilir denetim sonuçlarının elde edilmesine katkı sağlar, dolayısıyla iyi yönetişim ilkelerini destekler. Bu açıdan istatistiksel okuryazarlık iç denetçiler için sadece teknik bir yeterlik değil aynı zamanda stratejik bir araçtır. İstatistiksel okuryazarlık, istatistiksel bilgiyi anlama, yorumlama, eleştirel değerlendirme ve etkili bir şekilde sunma becerilerini kapsayan çok boyutlu bir kavramdır. İstatistiksel okuryazarlık; bilme (knowledge), yorumlama (interpretation) ve kritik yorumlama (critical interpretation) olmak üzere üç bilişsel yeterliliği dikkate almaktadır. Problemlerin çözümünde bilişsel faktörlerin yanında duyuşsal faktörlerin de dikkate alınması gerektiğine inanılmaktadır. Öz yeterlik öne çıkan duyuşsal faktörlerden birisidir. Öz yeterlilik kavramı, Bandura'nın sosyal bilişsel teorisine dayanır ve bireyin belirli bir görevi başarıyla tamamlayabilme kapasitesine ilişkin algısını ifade eder. Öz yeterliliğin, bireylerin matematiksel ve istatistiksel problem çözmeye yönelik inançlarını güçlendirerek, öğrenme ve başarının artırılmasında kritik öneme sahip olduğu düşünülmektedir. İstatistiksel bağlamda bu kavram, bireyin istatistikle ilgili görevleri ne kadar başarılı bir şekilde gerçekleştireceği konusundaki özgüvenini belirtir. İstatistiksel okuryazarlığa ait öz yeterlilik, bireylerin istatistiksel bilgiyi anlama, analiz etme, yorumlama ve uygulama konusundaki kendi yeteneklerine olan inancı olarak tanımlanabilir. Sevimli ve Aydın (2017) çalışmalarında, alana özgü öz yeterlilik sınamasının ölçümlemede ve değerlendirmede etkili olacağını belirtmiştir. O nedenle bu çalışmada öz yeterlik boyutu değerlendirilirken kişilerin genel özgüven duyguları değil istatistik alanı konusundaki öz yeterlik algıları ele alınmıştır. Çalışmanın bilişsel boyutu, bilginin kavranması ve yorumlanmasına odaklanırken, duyuşsal boyutu, öz yeterlik ve istatistiksel bilgilere yönelik duygu ve tutumları kapsamına almıştır.

Araştırmanın veri toplama aşamasında, Şahin (2012) tarafından geliştirilmiş olan ve istatistiksel okuryazarlığı bilişsel boyutuyla değerlendiren ölçek kullanılmıştır. Bu ölçeğin esas alınmasında GAISE (Guidelines for Assessment and Instruction in Statistics Education: GAISE, 2016) ilkelerine uygun olarak değerlendirilmesi etkili olmuştur. Temel alınan ölçeğin geliştirilmesi aşamasında, İktisadi ve İdari Bilimler, Mühendislik ve Fen Fakültelerinde verilen İstatistik derslerinin izlenceleri incelenerek verilen ortak konular belirlenmiş, temel istatistiksel yeterlilik anlayışı benimsenerek ölçek maddeleri geliştirilmiştir. Çalışmanın duyuşsal boyutunda ise Batur ve arkadaşlarının (2019) istatistiksel okuryazarlık inanç ölçeği kullanılmıştır. Bu ölçek, istatistiksel okuryazarlık modelindeki 'istatistiksel süreç', 'muhakeme', 'temel kavramların bilinmesi' bileşenlerine uygun olarak 5'li Likert ölçek türünde tasarlanmıştır. Bu çalışmada esas alınan istatistiksel okuryazarlık boyutunu temsil edecek maddeler belirlenerek çalışmaya dahil edilmiştir. İç denetim mesleği çerçevesinde oluşturulan anketin istatistiksel öz yeterlik bölümünde 14 soru, bilişsel değerlendirmeye olanak tanıyan bilgi bölümünde ise 11 soru (alt katman sorularıyla toplam 18 soru) yer almaktadır. Ayrıca demografik farklılıkları da yorumlayabilmek için 7 soru sorulmuştur.

Ankara Sosyal Bilimler Üniversitesi'nden etik kurul onayı alınmış anket formu Google forma aktarılarak meslek örgütlerinin desteğiyle kamu iç denetçilerin eposta adreslerine gönderilmiştir. Veri girişleri Temmuz 2024 ayı süresince devam etmiştir. Çalışma, anketi geçerli olan 109 katılımcı sonuçlarına göre değerlendirilmiştir.

Ankete katılan iç denetçilerin ortalama yaşının 47 olduğu, çoğunun 10 yıl ve altında meslekte kıdeme sahip olduğu görülmüştür. En çok denetim yapılan alan ise, %51 ile uygunluk denetimi ve %38 ile sistem denetimidir. Ankete katılan iç denetçilerin eğitim durumları incelendiğinde ise büyük çoğunluğunun (%61) İktisadi ve İdari Bilimler Fakültesi (İ.İ.B.F) mezunu, %37'sinin Mühendislik fakültesi mezunu olduğu, Fen-Edebiyat Fakültesi mezunu olanların oranının ise %2 olduğu görülmüştür. Katılımcıların %54'ü yüksek lisans ve %14'ü doktora eğitim seviyesine sahiptir.

Çalışmada kullanılan öz yeterlik ölçeğinin güvenilirliği katılımcılar açısından Cronbach's Alpha ile sınanmış ve 0,952 düzeyinde veri yapısının yüksek düzeyde güvenilirliği desteklediği görülmüştür. Ayrıca yapılan istatistiksel analizler faktör analizi için de uygun olduğunu göstermiştir. Faktör analizi sonucunda faktör yükleri, yamaç grafiği ve varyans açıklama oranları dikkate alınarak iki bileşende toplanabileceğine karar verilmiştir. İki bileşenin yükleri kullanılarak her katılımcı için öz yeterlik puanı hesaplanmıştır. Hesaplanan öz yeterlik puanları, yorumlama kolaylığı açısından interpolasyonla 0-100 aralığına getirilmiştir. Puanlar incelendiğinde, ankete katılan iç denetçilerin istatistiksel okuryazarlık konusunda ortalama düzeyde kendilerine güven duydukları görülmüştür (ortalama öz yeterlik puanı 65,833). İstatistiksel okuryazarlık inanç ölçeği puanı bakımından iç denetçiler; cinsiyetleri, eğitim düzeyleri, lisans mezuniyetleri, meslekteki kıdem süreleri ve denetim faaliyet alanlarına göre karşılaştırıldığında, incelenen bu gruplar arasında öz yeterlik inancı bakımından istatistiksel olarak anlamlı bir farklılaşma olmadığı görülmüştür. Bir başka deyişle, iç denetçilerin eğitim düzeyleri, lisans mezuniyetleri, meslekteki kıdem süreleri ve en çok denetim faaliyet gösterdikleri denetim alanı farketmeksizin, istatistiksel veri okuryazarlığı bakımından ortalama düzeyde kendilerine güvenmektedirler.

Çalışmanın bilişsel boyutunda, her sorunun ve her aşamanın aynı düzeyde değere sahip olduğu yaklaşımıyla doğru cevap sayıları üzerinden değerlendirme yapılmıştır. Ankete katılan iç denetçilerin ortalama doğru cevap sayısının 18 soru üzerinden yaklaşık olarak 9 olduğu görülmüştür. Bilişsel boyutun alt kategorileri olan "bilgi", "yorumlama" ve "kritik yorumlama" bölümleri ayrı ayrı ele alınmıştır. "Bilgi" alanında iç denetçilerin görsel betimleme araçlarına yönelik bilgileri sorgulanmıştır. Katılımcıların %50'si, bu başlıkta sorulan 3 sorudan 2'sine doğru cevap vermiştir. Yorumlama alanında örnekleme, olasılık ve dağılım bilgisi olmak üzere toplam 3 soru sorulmuştur. Bu sorulardan iki ve daha fazlasına doğru cevap veren iç denetçilerin oranı %90'dır. Kritik yorumlama bölümü ise, verilen bilgiyi yorumlama ve bağlam kurma becerisi ile ilişkili sorulardan oluşmaktadır. Bu kapsamda 12 soru sorulmuştur. Sorular, tanımlayıcı istatistiklerin yorumlanması, aykırı değerin varlığında tutum, koşullu olasılık yorumu ve neden-sonuç ilişkisi ile ilgilidir. Bu sorulara verilen yanıtlar değerlendirildiğinde, katılımcıların %65'inin soruların yarısından fazlasına (6'dan fazla) doğru cevap verdiği gözlenmiştir.

Literatür ve meslek özellikleri değerlendirildiğinde istatistiksel okuryazar bir iç denetçinin yorum ve kritik yorum alanlarında başarılı olması beklenmektedir. Bu çalışmada, ilgili alanlarda sorulan soruların yarısından fazlasını bilen iç denetçiler başarılı sayılmış ve istatistiksel okuryazar olarak tanımlanmıştır. Buna göre okuryazar olan iç denetçilerin oranının %61 olduğu görülmüştür. İstatistiksel okuryazar iç denetçilerin bazı demografik kırılımlara göre dağılımı incelendiğinde, %77'sinin erkek, %23'ünün kadın, %53'ünün İ.İ.B.F mezunu, %47'sinin Mühendislik Fakültesi mezunu olduğu gözlenmiştir. Ayrıca meslekteki kıdem süreleri bakımından %23'ü 5 yıl ve altında kıdeme sahipken, %40'ının 6-10 yıl, %11'inin 11-15 yıl, %26'sı 15 yıl ve üstü kıdeme sahiptir. İstatistiksel okuryazar iç denetçilerin %51'inin en çok denetim faaliyeti yürüttüğü alan uygunluk denetimi iken, %5'inin Mali, %11'inin BT denetimi ve %34'ünün sistem denetimi yaptığı görülmüştür. İncelenen bu demografik kırılımların istatistiksel okuryazar olma durumu üzerinde etkili olup olmadığı Ki-Kare Bağımsızlık testi ile araştırılmış, cinsiyetin, öğrenim durumunun ve en çok denetim faaliyeti yürütülen alanın iç denetçilerin okuryazar olma düzeyi üzerinde etkili olmadığı, bunun yanında lisans mezuniyeti alanının ve meslekteki kıdem süresinin ise iç denetçilerin istatistiksel okuryazarlık düzeyleri üzerinde etkili olduğu sonucuna ulaşılmıştır. Ayrıca iç denetçilerin istatistiksel okuryazarlık alanındaki özgüvenlerinin etkisini değerlendirmek için, öz yeterlik ortalamaları, istatistiksel okuryazar olan ve olmayan iç denetçiler bakımından ayrıca karşılaştırılmıştır. İstatistiksel okuryazar olarak tanımlanan ve tanım dışında kalan iç denetçilerin öz yeterlik puan farklarının istatistiksel olarak önemli olmadığı, istatistiksel okuryazar olan ve olmayan iç denetçilerin bu konuda kendilerine duydukları güvenin aynı olduğu, diğer bir ifadeyle ortalama inanç puanlarının benzer olduğu görülmüştür.

Araştırmanın genel bulguları, kamu iç denetçilerinin istatistiksel veri okuryazarlığı konusunda güçlü yanlara sahip olduklarını, ancak bu alandaki özgüvenlerinin geliştirilmesi gerektiğini göstermektedir. Literatürde de belirtildiği gibi, özgüvenin artırılması, bu alanın iş yaşamında daha etkin bir şekilde kullanılmasına olanak tanıyacaktır. İstatistiksel okuryazarlığın geliştirilmesi, kurumsal yönetişim süreçlerine ve veri odaklı karar alma mekanizmalarına da doğrudan katkı sağlayacaktır.

Bu çalışma, mesleki ele alış bakımından gelecek çalışmalara yönelik değerli bir temel oluşturmakta ve bu alanda daha ayrıntılı çalışmaların gerekliliğini ortaya koymaktadır. Örneğin, GAISE (2016) temel ilkeleri, temel kavramların anlaşılması ve yorumlama becerisi yanında teknolojik araçların kullanımı ve etik sorumluluk bilinci ilkelerini de içermektedir. Gelecekteki araştırmalar, istatistiksel okuryazarlık ile ilgili çeşitli meslek gruplarının farklılaşan ihtiyaçlarına özel çözümler sunabilir.